

AD/A-002 857

**A STRUCTURAL WEIGHT ESTIMATION PROGRAM  
(SWEEP) FOR AIRCRAFT. VOLUME V - AIR  
INDUCTION SYSTEM AND LANDING GEAR MOD-  
ULES. PART I: AIR INDUCTION SYSTEM  
MODULE**

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**Rockwell International Corporation**

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) Three computer programs were written with the objective of predicting the structural weight of aircraft through analytical methods. The first program, the structural weight estimation program (SWEEP), is a completely integrated program including routines for airloads, loads spectra, skin tem- peratures, material properties, flutter stiffness requirements, fatigue life, structural sizing, and for weight estimation of each of the major aircraft structural components. The program produces first-order weight estimates		

(471)

and indicates trends when parameters are varied. Fighters, bombers, and cargo aircraft can be analyzed by the program. The program operates within 100,000 octal units on the Control Data Corporation 6600 computer. Two stand-alone programs operating within 100,000 octal units were also developed to provide optional data sources for SWEEP. These include (1) the flexible airloads program to assess the effects of flexibility on lifting surface airloads, and (2) the flutter optimization program to optimize the stiffness distribution required for lifting surface flutter prevention.

The final report is composed of 11 volumes. This volume (volume V) contains the methodology program description, and user's information for the air induction system and landing gear modules of SWEEP.

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## PREFACE

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### Volume

I	"Executive Summary"
II	"Program Integration and Data Management Module"
III	"Airloads Estimation Module"
IV	"Material Properties, Structure Temperature, Flutter, and Fatigue"
V	"Air Induction System and Landing Gear Modules"
VI	"Wing and Empennage Module"
VII	"Fuselage Module"
VIII	"Programmer's Manual"
IX	"User's Manual"
X	"Flutter Optimization Stand-Alone Program"
XI	"Flexible Airloads Stand-Alone Program"

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## INTRODUCTION TO VOLUME V

The Structural Weight Estimation Program (SWEET) has been developed as an analytical aircraft structural weight prediction tool suitable for use in the preliminary design phase of vehicle synthesis. The functions of data development and assessment have been integrated into various program modules so that criteria, design constraints, and environment considerations are consistent. The purpose of the two parts of this volume is to present methods and formulations and to discuss program routines for the air induction system and landing gear modules:

- Part 1 discusses the air induction system module, which estimates air induction system, nacelle, and engine section structure weights
- Part 2 discusses the landing gear module

Appendix A presents autoflow diagrams and charts of the air induction system module. Autoflow diagrams and charts of the landing gear module are presented in Appendix B.

**PART 1**

**AIR INDUCTION SYSTEM MODULE**

## Section I

### INTRODUCTION AND SUMMARY

#### PROGRAM OBJECTIVES

The objective of the air induction system weight estimation module is to provide weight of propulsion-system-oriented structural components during the preliminary design phase of vehicle synthesis. In this design phase, weight trade-off and point design data sensitive to a wide range of inlet-engine arrangements and design criteria are required.

Design of propulsion systems are, to a significant degree, dictated by optimum performance to meet primary mission objectives with compromise for other vehicle environmental conditions encountered by the system. Inlet boundary layer bleed and bypass requirements are some of many details that are not available in the preliminary design phase. These and other factors complicate structural arrangement definitions which are required in an analytical procedure.

Methods that are incorporated in this program evaluate those components that may be derived on an analytical basis within the limitations of design data that would be available in the preliminary design phase. Empirical and statistical formulations are used to estimate the weight for certain identifiable components as well as to estimate provisions for items that are not readily defined.

#### SUMMARY OF ANALYSIS CAPABILITIES AND LIMITATIONS

The estimating procedure accounts for wing-pylon-mounted or fuselage-pylon-mounted engine packages as well as for engines mounted inside the vehicle fuselage. It is limited to air-breathing engine concepts with inlet ducts forward of the engine compressor face. Nacelle-type installation evaluation is limited to two or four nacelle arrangements. The following propulsion-system-oriented components are evaluated in this module:

- Air induction system:
  - Ducts
  - Variable - geometry ramps

- Auxiliary inlet panels
- Duct bypass doors
- Fixed- and variable-geometry spikes
- Nacelle and engine section:
  - Nacelles and engine cowling
  - Pylons
  - Fittings
  - Engine mounts

For the purposes of weight accounting, air induction system structure is categorized as part of the propulsion group according to the definitions in MIL-STD-254. Nacelle and engine section structure components are categorized in a separate group. The weight estimating approach is based on calculating weights at the line item level of the detail weight statement report form, Figures 1 and 2.

The program approaches weight estimation for each of the structural elements as independent entities. Some interactive compatibility is evaluated such as optimum duct frame spacing or for duct requirements due to the presence of ramps.

#### AIR INDUCTION SYSTEM STRUCTURE WEIGHT ESTIMATION

Inlet duct and variable-geometry ramp structure weight estimation procedures account for factors such as geometry, type of construction, material properties, temperature, inlet pressures, and manufacturing limitations. Auxiliary inlet panels, duct bypass doors, and fixed- and variable-geometry spikes are estimated by statistical methods. Weights of these items are sensitive to specific item function and dimensional and descriptive data input by the user.

#### Inlet Pressure and Temperature

Inlet design pressures and temperature are determined for the vehicle speed-altitude profile envelope. Nine points on both the level-flight

NAME \_\_\_\_\_  
DATE \_\_\_\_\_

## PROPULSION GROUP

**PAGE** \_\_\_\_\_  
**MODEL** \_\_\_\_\_  
**REPORT** \_\_\_\_\_

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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1	2	3	4	5	6	7	8	9	10	11	1																																																																																								

**Figure 1. Detail weight report format for propulsion group.**

ENGINE SECTION OR  
NACELLE GROUP

	Inboard	Center	Outboard	
1				
2				
3				CODE NO.
4				ENGINE MOUNT
5				
6				SUPPORT RAY
7				VIBRATION ABSORPTION DEVICES
8				
9				
10				NACELLE STRUCTURE
11				BULKHEADS AND FRAMES
12				COVERING & STIFFENERS
13				FITTINGS
14				LONGERONS
15				ATTACHING ANGLES, ETC.
16				
17				
18				
19				PYLONS & STRUTS
20				
21				
22				
23				FIREWALL
24				
25				SHROUDS FOR FIRE PROTECTION
26				
27				COWLING
28				ENGINE COWL
29				
30				
31				
32				
33				
34				
35				BAFFLES
36				ACCESSORY COWL OR SKIRT
37				COWL FLAPS
38				COWL FLAP CONTROLS & OPERATING MECH.
39				
40				
41				
42				
43				
44				
45				FANING - NACELLE TO WING OR PYLON
46				STRIPS & GRIPS
47				WORKING PLATFORM (ONLY ON
48				INTERNAL WALKWAYS
49				
50				
51				INSTALLATION HARDWARE
52				
53				
54				
55				
56				TOTALS - SECTIONS OR NACELLES
57				TOTAL (TO BE BROUGHT FORWARD)

\*If in nacelle, or sub-structure in wing or body.

Figure 2. Detail weight report format for engine section or nacelle group.

# **NACELLE GROUP** **DOORS, PANELS & MISCELLANEOUS**

1	2	3	4	5	Operating Mechanism				
					Mechanism & Controls	Power Trans.	Actuator	Lock Mech.	Emrg.
6	7	8	9	10	11	12	13	14	15
16	17	18	19	20	21	22	23	24	25
26	CODE NO.								
27	DOORS & FRAMES								
28	- LANDING								
29									
30	- BOMB								
31									
32	- ACCESS								
33									
34	- ENGINE								
35									
36									
37									
38									
39									
40									
41									
42									
43									
44									
45									
46									
47									
48									
49									
50									
51									
52	EXTERIOR FINISH								
53									
54	TOTALS								
55	TOTAL - DOORS, PANELS & MISC.								
56	TOTAL FROM PG 15								
57	TOTAL - ENGINE SECTION OR NACELLE GROUP								

\*Indicate location for major doors by int'd, center, out'd.

\*\*H-Hydraulic, E-Electrical, P-Pneumatic; power transmission from main distribution point to actuating unit.

Figure 2. Detail weight report format for engine section or nacelle group (concl).

maximum speed ( $M_H$ ) and the limit speed ( $M_L$ ) envelopes are evaluated for design pressure and temperature data based on standard day atmospheric properties. Total pressure is calculated by using isentropic compressible flow equations and inlet pressure recovery ratio. Static pressure is calculated as a function of total pressure and airflow. Transient overpressure, referred to as hammershock, is calculated as a function of inlet total pressure and engine bypass ratio. Inlet attenuation is approximated to develop longitudinal pressure variation in the duct.

### Material Properties

Material properties in the form of stress-strain diagrams, strength and fatigue characteristics, and physical properties are stored in a permanent data bank. Elevated-temperature properties are obtained by interpolation of the permanent file data. Properties for ducts, ramps, and nacelle are independently derived such that different materials may be selected for these structural components.

Since temperature varies with vehicle speed and altitude, separate sets of materials data are calculated for each speed profile point. Components are designed to the pressure loads and the attendant material properties.

### Inlet Ducts

The inlet duct weight estimating approach is a multi-station synthesis procedure. Geometry is represented as a family of shapes (rounded rectangles) that may be defined by straight lines and circular arcs. Shape may vary from fully circular to fully rectangular. Inlet geometry is defined at as many as 10 discrete synthesis locations, starting at the leading edge and ending at the engine front face.

Ducts are assumed to be sheet frame structure designed to pressure requirements. Panels are designed for either milled with lands at frames or unmilled construction. Strength, deflection restraint, and fabrication minimums are variables; frame spacing may be either fixed or variable. The optimum frame spacing search is conducted between predefined minimum and maximum limits.

### Variable-Geometry Ramps

Either two, three, or four ramp systems are evaluated. Variables in the weight estimation approach are differential ramp pressures, geometry, material properties, construction, and fabrication minimums.

Critical design pressure is determined by comparing the ratio of ultimate hammer shock pressure to the ramp material compression yield stress at each of the points on the speed profile envelope. Differential pressure on each ramp, a function of plenum pressure, is based on either predefined or user input pressure ratios.

Geometric descriptions of lengths, widths, angles, and actuator locations are combined to develop individual ramp loading diagrams. These loads are used to synthesize either stiffened sheet construction or honeycomb panel structure.

#### NACELLE AND ENGINE SECTION WEIGHT ESTIMATION

Nacelle structure weight estimates are performed for external podded engine installations. Geometry is defined in a manner similar to that used for the ducts. Synthesis cut geometry is defined at as many as 10 stations, starting at the inlet leading edge and ending at the last complete nacelle section.

Nacelle loads due to inertia effects are considered to be negligible. This premise is true for most nacelle systems in which engines are supported directly by the pylon strut. The estimating procedure is therefore limited to the design for local panel flutter, if critical, and fabrication minimums. Within this scope, frame weight and spacing compatibility is maintained forward of the engine front face. Duct frame weight and spacing are used in this forward section. Frame spacing aft of the engine face is defined by input definition.

Pylons, fittings, engine mounts, firewall, and miscellaneous door weights are calculated by empirical and statistical methods.

#### MODULE OPERATION

The program is written in FORTRAN extended language for operation on the CDC 6600 computer and is structured to operate within 50,000-octal core locations. Execution time varies with the type of inlet-engine arrangement. The range of computer core time varies between 1 to 5 system seconds.

The air induction system module operates within SWEEP either as a stand-alone program or in conjunction with other modules. Mode of operation is controlled by the SWEEP control program, OLAY00.

In the stand-alone mode, the SWEEP control program calls only the input data processing module and the air induction system module. All input data, required by the air induction system module are initially set up by the user, read by the input data processing module, and set up in labeled common and mass storage records for use by the air induction system module.

When the air induction system module is operated in conjunction with other SWEEP modules, input data are processed in the same manner as those used in the stand-alone mode. Part of the data required by the data management module are also used by the air induction system module. In this case, duplicated data are transferred to the input data record for use by the air induction system module.

Specific input data requirements and deck arrangement instructions are discussed in Volume IX, "User's Manual."

#### MODULE INPUT

Specific input to the air induction system module is discussed in the maps and program descriptions contained in Section III of this volume. Following is a summary of the types of input required by the module:

1. Basic constants used in synthesis equations: 275 inputs
2. Air induction system, nacelle, and engine section configuration dependent data: 260 inputs
3. Mach-altitude profile data: 30 inputs
4. Materials data:  $\leq 300$  inputs per material used
5. Program print indicators: 10 inputs

#### MODULE OUTPUT

Basic module weight summary results are shown in Figures 3 through 5. Optional output, which is controlled by user specifications, consists of input data tables, loads and sizing data tables, weight details, and intermediate calculations. Sample output tables are shown with the descriptions of the source routines in Section III of this volume. Warning and error messages are printed when erroneous or incompatible data are encountered. The program default procedure appears as part of the message.

3 OCT 1973

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# 3. I. S. & ENGINE SECTION OR NACELLE GROUP WEIGHT & C.G. SUMMARY

	INBOARD		OUTBOARD		TOTAL	
	WT.	C.G.	WT.	C.G.	WT.	C.G.
AIR INDUCTION SYSTEM						
INLET WEDGE	1899.44	2023.33	0.0	0.0	33007.39	2497.92
AIR DUCTING	27221.94	2548.41	0.0	0.0		
INTAKE DOORS & OP. MECHANISM	0.0	1960.00	0.0	0.0		
BYPASS DOORS & OP. MECHANISM	0.0	1960.00	0.0	0.0		
VARIABLE GEOMETRY STRUCTURE	3986.01	2378.06	0.0	0.0		
HALF ROUND FIXED SPIKE	0.0	1960.00	0.0	0.0		
FULL ROUND TRANSLATING SPIKE	0.0	1960.00	0.0	0.0		
FULL TRANS. & EXPND. SPIKE	0.0	1960.00	0.0	0.0		
ENGINE MOUNTS	1263.15	2868.00	0.0	0.0		
QUILKHEADS & FRAMES	16245.05	2511.15	0.0	0.0		
COVERING & STIFFENERS	7223.28	7665.63	0.0	0.0		
LONGERONS	0.0	1960.00	0.0	0.0		
FITTINGS	234.64	2868.00	0.0	0.0		
PYLONS	0.0	1960.00	0.0	0.0		
FIRFWALL	120.21	2766.00	0.0	0.0		
SHROUD	1590.10	2906.50	0.0	0.0		
TOTAL ENG.SEC./NAC.	26685.43	2597.84	0.0	0.0	26685.43	2597.84
ACCESS DOORS	0.0	1960.00				
ENGINE DOORS	1600.92	2906.50				
EXTERIOR FINISH	167.30	2503.50				
TOTAL MISC.						
					1768.22	2868.37
TOTAL ENG.SEC./NAC.GROUP & MISC.					28453.64	2614.65

Figure 3. Sample output of weight summary and balance results.

VAP I-SWEEP WING CONFIGURATION		3 OCT 1973	** SUMMARY **
*** PROPULSION GROUP ***			
-----			
AIR INDUCTION SYSTEM			
INLET WEDGE		1899.64	
AIR DUCTING		27221.94	
INTAKE DOORS & OPERATING MECHANISM		0.0	
BYPASS DOORS & OPERATING MECHANISM		0.0	
VARIABLE GEOMETRY STRUCTURE		3996.01	
			13007.39

Figure 4. Sample output of air induction system structure weight summary.

# VART-SWEEP WING CONFIGURATION

3 OCT 1973

\*\*\* SUMMARY \*\*\*

ENGINE SECTION OR NACELLE GROUP	INBOARD	OUTBOARD	TOTAL
ENGINE MOUNTS	1263.15	0.0	
NACELLE STRUCTURE			
BULKHEADS & FRAMES	16245.05	0.0	
COVERING & STIFFENERS	7723.28	0.0	
LONGERONS	0.0	0.0	
FITTINGS	234.64	0.0	
PYLON	0.0	0.0	
FIREWALL	120.21	0.0	
SHROUD	1599.10	0.0	
TOTAL	26685.43	0.0	26685.43
DOORS & MISCELLANEOUS			
DOORS			
ACCESS	0.0		
ENGINE	1600.92		
EXTERIOR FINISH	167.30		
TOTAL DOORS & MISCELLANEOUS			1768.22
TOTAL ENGINE SECTION OR NACELLE GROUP			28453.64

Figure 5. Sample output of engine section or nacelle group weight summary.

## MODULE STRUCTURE

The module is structured in a single overlay consisting of a main program (AISMN) and 21 subroutines. Figure 6 is a functional flow diagram which depicts the major operations of the program. Table 1 shows the routines for each of the functional groupings.

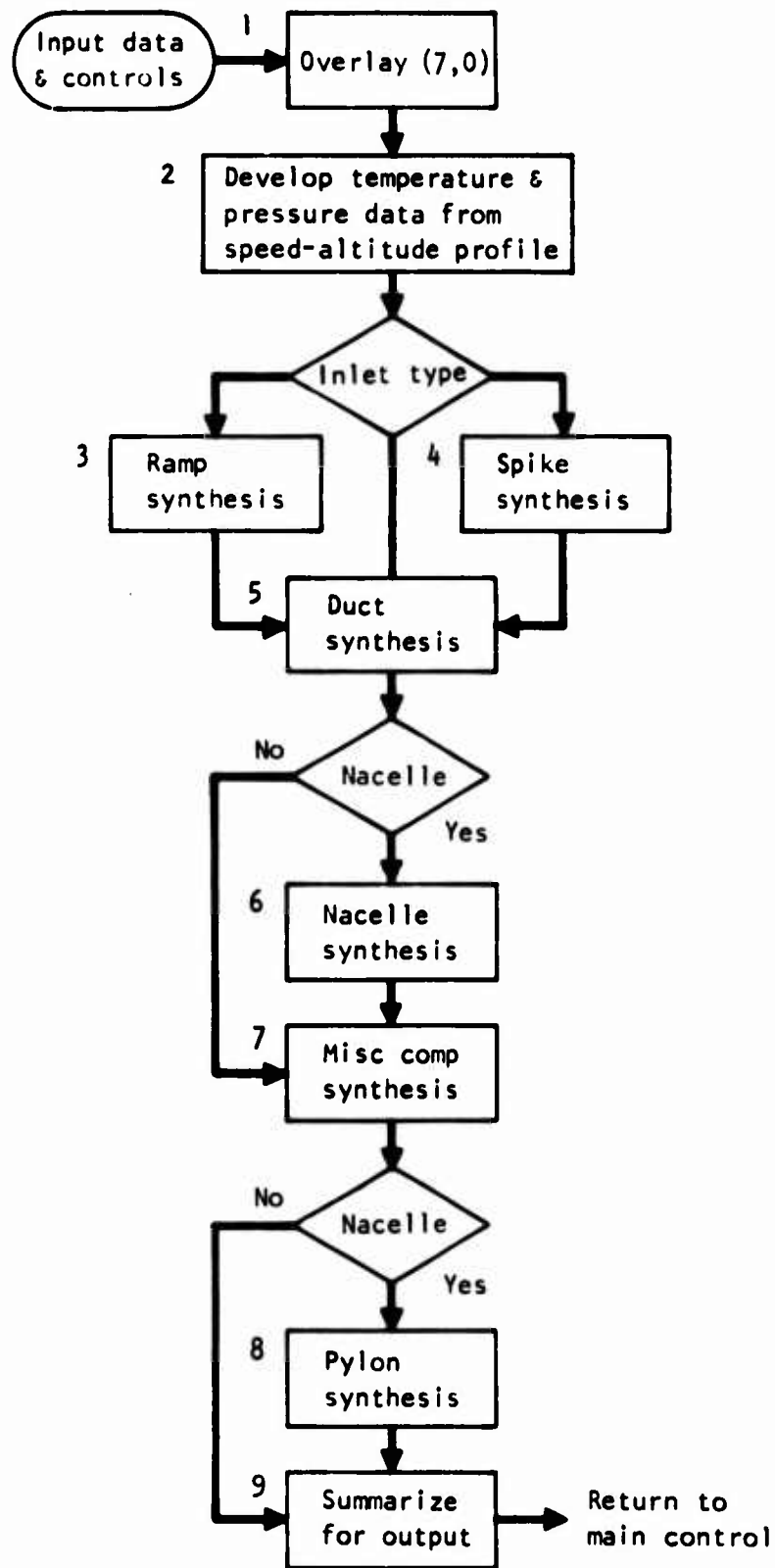


Figure 6. Air induction system module functional flow diagram.

**TABLE 1. FUNCTIONAL SUBROUTINE GROUPING (AIS)**

Overlay (7,0) Subroutine by Functional Groupings	
1. Overlay (7,0) Control and Data Manipulation	<ul style="list-style-type: none"> <li>● Program AISMN - Program for AIS overlay, print system data</li> </ul>
2. Develop Temperature and Pressure Data From Speed-Altitude Profile	<ul style="list-style-type: none"> <li>● Subroutine SPAL - Set up temp and pressure for 9 PT speed profile</li> <li>● Subroutine TEMPR - Temp/pressure eval program at given geopotential alt</li> <li>● Subroutine DSGNP - Set up temp and pressure factors for air induction sys</li> <li>● Subroutine MCNTL1 - Develop material properties from library data</li> <li>● Subroutine MATLF1 - Material property curve fit program</li> <li>● Subroutine MATLP2 - Material property curve fit program</li> </ul>
3. Ramp Synthesis	<ul style="list-style-type: none"> <li>● Subroutine RAMPS - Ramp synthesis and weight for 2 to 4 ramps per inlet</li> <li>● Subroutine PRECRT - Determine critical RAMP design criteria</li> </ul>
4. Spike Synthesis	<ul style="list-style-type: none"> <li>● Subroutine SPIKE - Weight for spikes by statistical equations</li> </ul>
5. Duct Synthesis	<ul style="list-style-type: none"> <li>● Subroutine DUCTS - Control and print for ducts</li> <li>● Subroutine DUCTGEO - Duct geometry evaluation program</li> <li>● Subroutine FRMND3 - Frame node coordinates 61 nodes evaluation program</li> <li>● Subroutine FRMELD - Unit pressure ring load evaluation program</li> <li>● Subroutine DUCPNL - Duct panel synthesis program</li> <li>● Subroutine DUCFRM - Duct frame synthesis program</li> <li>● Subroutine DUCWET - Duct weight evaluation program - per nacelle or A/V</li> </ul>
6. Nacelle Synthesis	<ul style="list-style-type: none"> <li>● Subroutine NACELE - Nacelle shell weight</li> <li>● Subroutine NCLGEO - Develop nacelle geometry</li> </ul>
7. Miscellaneous Component Weights	<ul style="list-style-type: none"> <li>● Subroutine MISCOM - Weights of engine mounts, misc doors, etc; apply K-factor</li> </ul>
8. Pylon Synthesis	<ul style="list-style-type: none"> <li>● Subroutine PYLONS - Pylon and fitting weight</li> </ul>
9. Summarize for Output	<ul style="list-style-type: none"> <li>● Subroutine SUMARY - Summarize AIS weights and CGS, and print</li> </ul>

## Section II

### METHODS AND FORMULATIONS

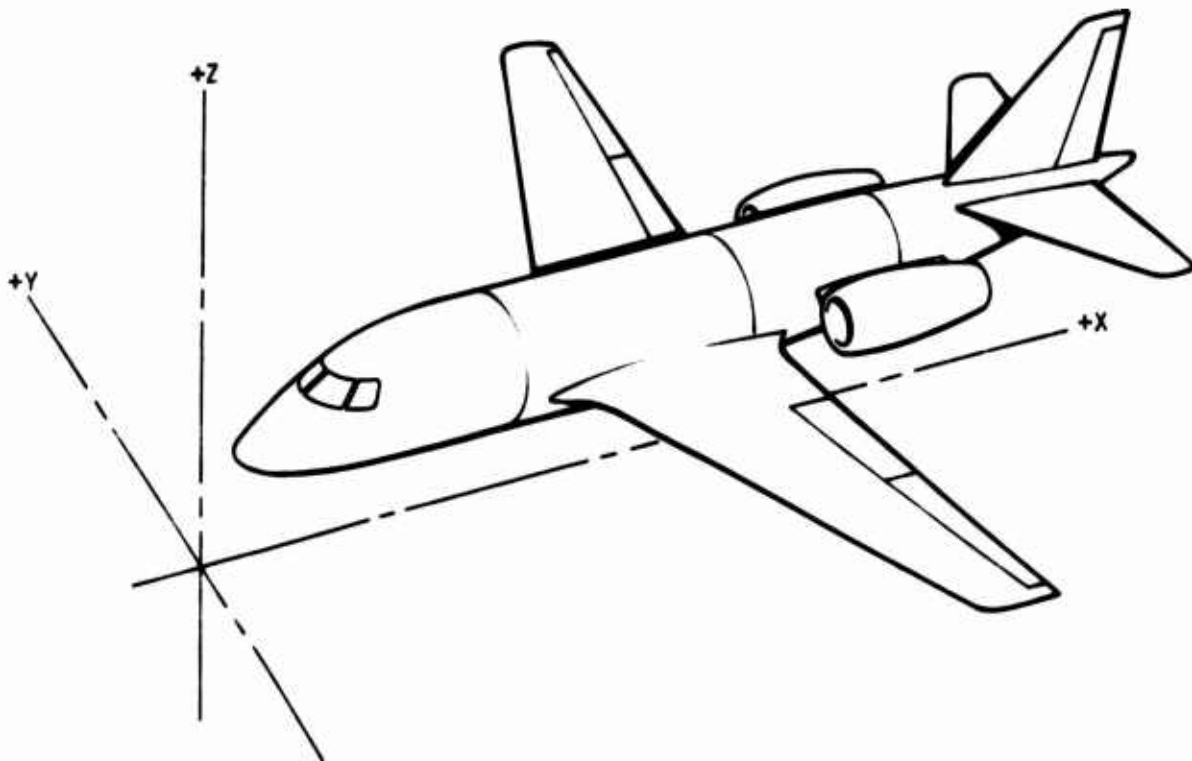
#### GENERAL DISCUSSION

Methods and formulations which are programmed in the air induction system weight estimation module are discussed in this section. Specific design data development and weight calculation functions are performed in separate routines which are called by the control program AISN. The discussions that follow present the process within each of these routines.

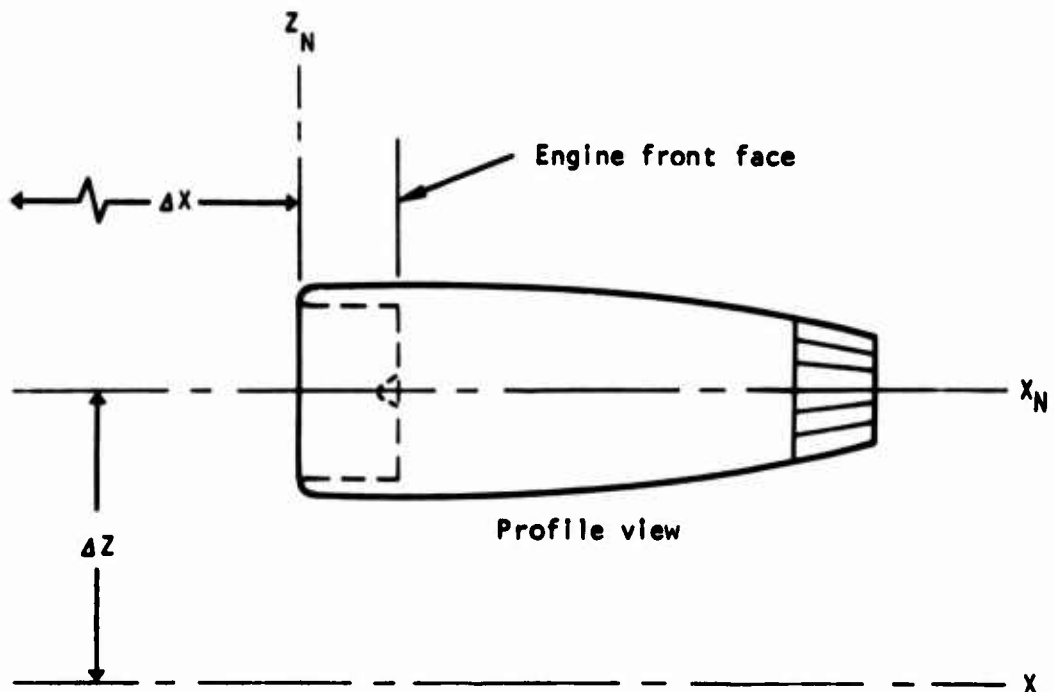
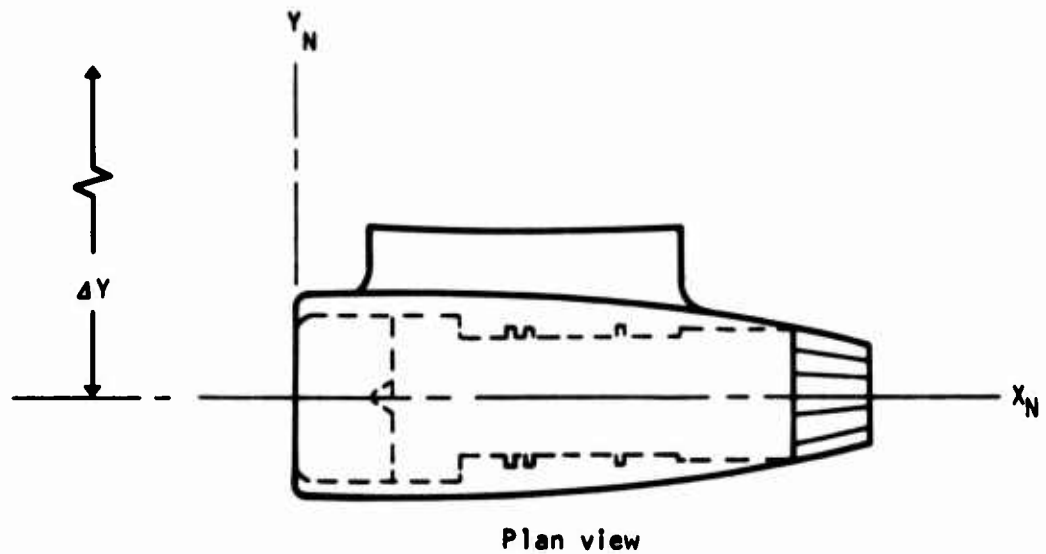
#### INLET COORDINATE SYSTEM

The air induction system weight estimation module, which is part of an integrated structure weight estimation program, provides propulsion system oriented structure weight. The procedure evaluates a wide range of propulsion system arrangements that can exist on fighter, attack, bomber, and transport vehicle categories. In order to minimize geometry definition requirements, an inlet coordinate system is used to locate and define structural components.

The following stability axis definitions are used to define the vehicle coordinate system.

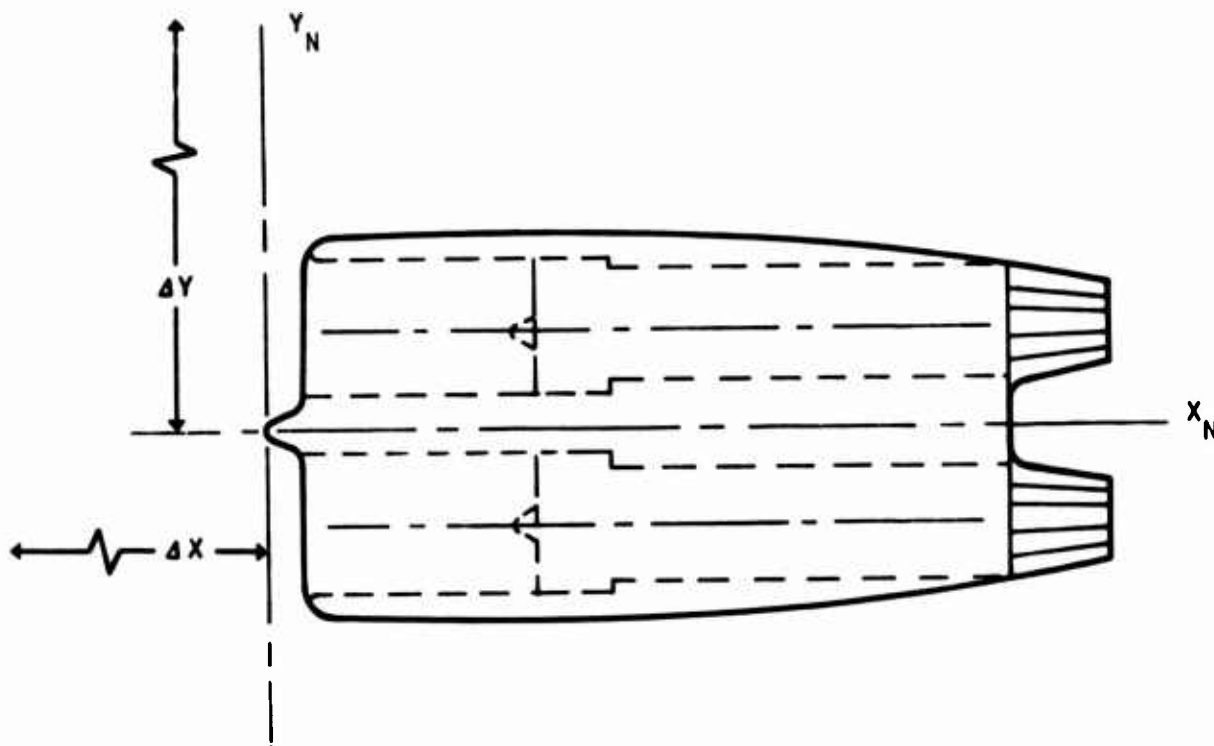


Propulsion systems, as with other systems such as the wing, are generally symmetrical. In the following sketch, left- and right-hand side engine packages are symmetrical. The inlet coordinate system is located relative to the vehicle coordinate system, as shown in the following sketches:



This coordinate system is offset from the vehicle coordinate system by  $\Delta X$ ,  $\Delta Y$ , and  $\Delta Z$ . Origin of the system,  $X_N = 0$ , is defined to be at the inlet leading edge. Origin of the other axes,  $Y_N = 0$  and  $Z_N = 0$ , is defined to be at the engine front face perpendicular to the engine axis,  $X_N$  - axis is assumed to be colinear with the engine axis.

Two engines may exist in a nacelle, as shown in the following sketch. The  $X_N$  - axis is located colinear with the engine axis midway between the engines (nacelle centerline).



This definition of inlet coordinate system also applies to fuselage-buried-engine arrangements. For this situation, inlet and vehicle Y-axis are coincident.

Geometric description and weight estimation of a single unit (one nacelle or one duct) can be evaluated. Total vehicle arrangement and weight is implied by the relative location with respect to the vehicle coordinate system and the inlet coordinate system. For the foregoing discussion of a two-engine arrangement, geometry of one inlet duct would be defined and presence of two ducts in the nacelle defined by the offset relative to the inlet coordinate system. There may be either two or four nacelles on a vehicle; i.e., an inboard set or an inboard and an outboard set. Therefore, the number of nacelles and their relative location ( $\Delta X$ ,  $\Delta Y$ ,  $\Delta Z$ ) can be used to determine the total number of detail units (such as number of ducts), total weight, and center of gravity. This accounting procedure is followed in the weight calculation routines and the weight summary subroutine SUMMARY.

## FLIGHT PROFILE AND DESIGN PRESSURES

The vehicle speed-altitude profile is evaluated for air induction system design pressures and local panel flutter requirements. Methods employed to develop and process this information are described herein. Routines which perform these operations are:

- SPAL Expand the input speed-altitude profile and calculate total temperature, total pressure, static inlet duct pressure, and dynamic pressure.
- TEMPR Calculate standard atmosphere temperature and pressure at speed profile altitudes.
- DSGNP Calculate inlet duct hammer shock pressures and static pressure at the inlet throat.

### SPEED-ALTITUDE PROFILE

Input speed-altitude profile data consist of five points on both the level-flight maximum speed envelope,  $M_H$ , and the limit speed envelope,  $M_L$ , starting at sea level and extending to maximum altitude. Points on the  $M_L$  profile are defined relative to the  $M_H$  profile. Data type and its use in the program are as follows:

<u>Input Data Defining <math>M_L</math></u>	<u>Description</u>
0.0	$M_L$ equal to $M_H$
>0; <1.0	Decimal to be added to $M_H$
>1.0	Multiplier of $M_H$
<0.0	Fraction of $M_H$ to be added to $M_H$

This data set is expanded to define nine points by interpolating between the input points. Intermediate points are taken at altitudes midway between input altitudes; corresponding dynamic pressure is obtained by interpolation, and speed is then calculated to be compatible with the dynamic pressure and altitude. Figure 7 shows these speed-altitude profile points.

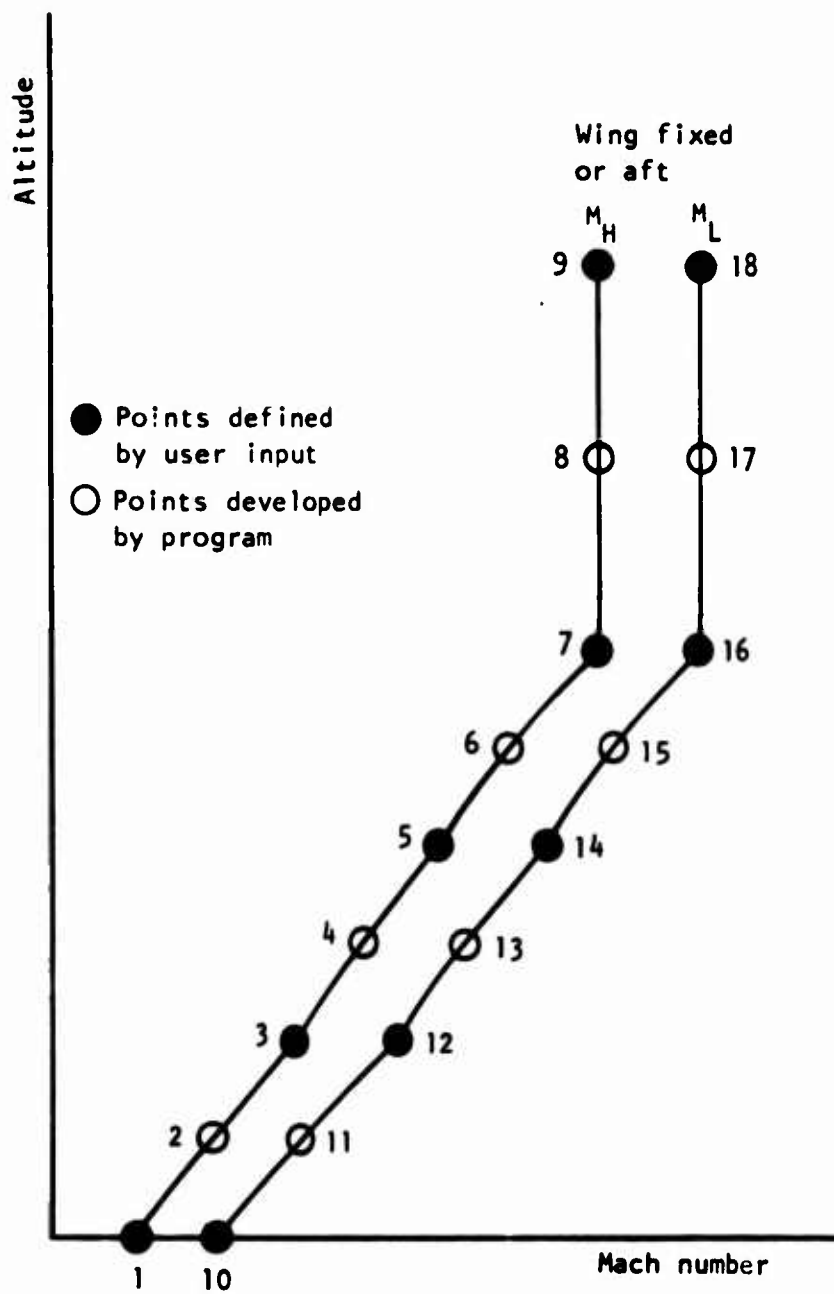


Figure 7. Speed-altitude profile points.

### Ambient Temperature and Pressure

U.S. standard atmosphere temperature,  $T_o$ , and pressure  $P_o$ , are calculated in subroutine TEMPR by curve fit equation for different altitude ranges. (1)

Between 0 and 36,089.24 feet,

$$T_o = 518.67 - 3.56616 (\text{ALT}) \quad (1)$$

$$P_o = 2116.22 [1.0 - 0.00687559 (\text{ALT})]^{5.25591} \quad (2)$$

where

$T_o$  = ambient temperature, °R

$P_o$  = ambient pressure, psf

ALT = geopotential altitude, ft/1,000

Between 36,089.24 and 65,616.88 feet,

$$T_o = 389.97 \quad (3)$$

$$P_o = \frac{472.68}{e^{\left(\frac{\text{ALT} - 36.08924}{20.80556}\right)}} \quad (4)$$

Between 65,616.88 and 104,986.9 feet,

$$T_o = 389.97 + 0.548641 (\text{ALT} - 65.61688) \quad (5)$$

$$P_o = 114.345 \left[ 1.0 + \frac{0.548641 (\text{ALT} - 65.61688)}{389.97} \right]^{-34.1634} \quad (6)$$

Between 104,986.9 and 154,199.5 feet,

$$T_o = 411.57 + 1.53619 (ALT-104.9869) \quad (7)$$

$$P_o = 18.131 \left[ 1.0 + \frac{1.53619 (ALT-104.9869)}{411.57} \right]^{-12.2012} \quad (8)$$

Should the altitude exceed 154,119.5 feet, a warning message is printed, equation 7 is used to calculate  $T_o$ , and equation 8 is used to calculate  $P_o$ .

### Dynamic Pressure

Dynamic pressure is calculated in subroutine SPAL by using local temperature and pressure, equation fit approximation of the acceleration of gravity, and assuming constant specific heat ratio.

$$g = 32.17405 - 0.00000304 ALT \quad (9)$$

$$\rho = \frac{P_o}{RT_o} \quad (10)$$

$$C_s = \sqrt{\gamma g R T_o} \quad (11)$$

$$q = \frac{\rho}{2g} (M_o C_s)^2 \quad (12)$$

where

$g$  = acceleration of gravity,  $\text{ft/sec}^2$

$\rho$  = density of air,  $\text{lb/ft}^3$

$R$  = gas constant,  $53.3 \text{ ft-lb/lb/}^\circ\text{R}$

$\gamma$  = ratio of specific heats, 1.4

$C_s$  = speed of sound, ft/sec

$M_o$  = vehicle mach number

$q$  = dynamic pressure, psf

#### INLET DUCT PRESSURES AND TEMPERATURES

Inlet duct pressures and temperatures are calculated at each of nine points on the level-flight maximum speed envelope,  $M_H$ , and the limit speed envelope,  $M_L$ . Hammershock pressure is determined at points on the  $M_H$  and  $M_L$  profiles, and static pressure is determined along the  $M_L$  profile. These pressures are determined at the inlet throat and at the front face of the engine. Pressure from the leading edge to the throat is assumed to be constant. Pressure at inlet stations between the throat and the engine are determined by linear interpolation between pressures at the two points.

Total pressures and temperatures are calculated in subroutine SPAL. Static pressures at the engine face are also calculated in SPAL. Hammershock pressures and static pressures at the inlet throat are calculated in subroutine DSGNP. Isentropic compressible flow equations and empirical formulations for pressure recovery ratio, airflow, and attenuation are used to calculate the required data. The subscript, (1), is used to denote inlet throat station, and the subscript, (2), to denote engine front face station in the discussions that follow.

#### Total Temperature and Pressure

Total temperature,  $T_{T2}$ , and total pressure,  $P_{T2}$ , are calculated by equations 13 and 14.

$$T_{T2} = T_o \left( 1 + \frac{\gamma-1}{2} M_o^2 \right) \quad (13)$$

$$P_{T2} = (P_{T2}/P_{T0}) P_o \left( 1 + \frac{\gamma-1}{2} M_o^2 \right)^{\frac{\gamma}{\gamma-1}} \quad (14)$$

where

$P_{T2}/P_{T0}$  = inlet pressure recovery ratio

Pressure recovery ratio may be user input. However, if it is not available, equation 15 from reference 2 is used to calculate recovery ratio for supersonic speeds. For subsonic speeds, recovery ratio is assumed to be 1.0.

$$P_{T2}/P_{T0} = 1.0 - 0.075 (M_0 - 1.0)^{1.35} \quad (15)$$

### Static Pressure

Static pressure at the engine face,  $P_2$ , is calculated by equation 16.

$$P_2 = \frac{P_{T2}}{\left(1 + \frac{\gamma-1}{2} M_2^2\right)^{\frac{\gamma}{\gamma-1}}} \quad (16)$$

where

$M_2$  = mach number of air at engine face

Mach number of the air at the engine face may be user input or, if not available, is defined by the following approximations:

$$M_2 = 0.3 \quad \text{when } M_0 > 1.0$$

$$M_2 = 0.5 \quad \text{when } M_0 \leq 1.0$$

Static pressure at the inlet throat,  $P_1$ , is obtained from the curve of the ratio of static pressure to free-stream total pressure versus mach number

(Figure 8). This ratio, which is the pressure ratio behind the normal shock, is calculated by equation 17.

$$P_1/P_{T0} = 0.8 - 0.05M \quad (17)$$

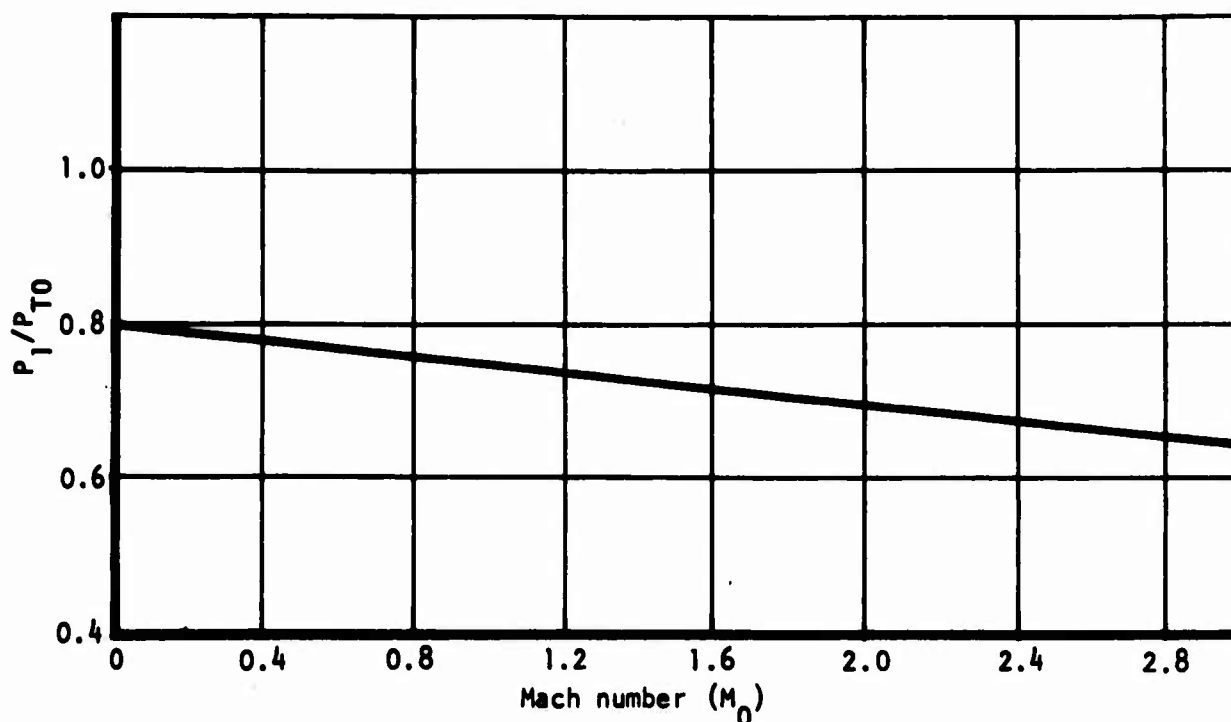


Figure 8. Throat static pressure ratio.

### Hammershock Pressure

Hammershock pressure in the inlet system is caused by engine stall and consequent airflow cutoff. This pressure is dependent on internal engine geometry. Hard stall of turbojet engines creates hammershock pressure ratios,  $P_{HS2}/P_2$ , of about 2, which indicates 100-percent inlet flow cutoff. In the case of fan engines, most of the stalls occur in the high-pressure compressor. As the hammershock pulse emerges from the compressor, the fan bypass ducting provides a path through which the pulse is vented; step change in fan back-pressure is reduced, and pressure rise in the inlet duct is correspondingly lower. As the bypass ratio of the fan is increased, the relative air mass

involved with compressor stall decreases, fan air bypass duct volume increases, and pressures forward of the fan are lower. Plots of hammershock pressure ratio versus total temperature,  $T_{T2}$ , for turbojet and fan engines are shown in Figure 9. These curves are based on corrected airflow,  $f(M_2)$ , versus total temperature data for typical engines, and hammershock pressure ratio data from Reference 3. Equations 18, 19, 20, and 21 approximate these curves and are used to calculate the pressure ratio for different engines.

- Turbojet:

$$P_{HS2}/P_{T2} = 1.019056 - 0.0289156 \left( \frac{T_{T2}}{400} \right) + 1.350112 \left( \frac{400}{T_{T2}} \right) - 0.664319 \left( \frac{400}{T_{T2}} \right)^2 \quad (18)$$

- Fan engine:  $BPR \leq 1.5$

$$P_{HS2}/P_{T2} = -0.00602627 + 0.080725 \left( \frac{T_{T2}}{400} \right) + 3.16503 \left( \frac{400}{T_{T2}} \right) - 1.588524 \left( \frac{400}{T_{T2}} \right)^2 \quad (19)$$

- Fan engine:  $1.5 < BPR \leq 2.5$

$$P_{HS2}/P_{T2} = -0.770476 + 0.1482515 \left( \frac{T_{T2}}{400} \right) + 4.371758 \left( \frac{400}{T_{T2}} \right) - 2.114969 \left( \frac{400}{T_{T2}} \right)^2 \quad (20)$$

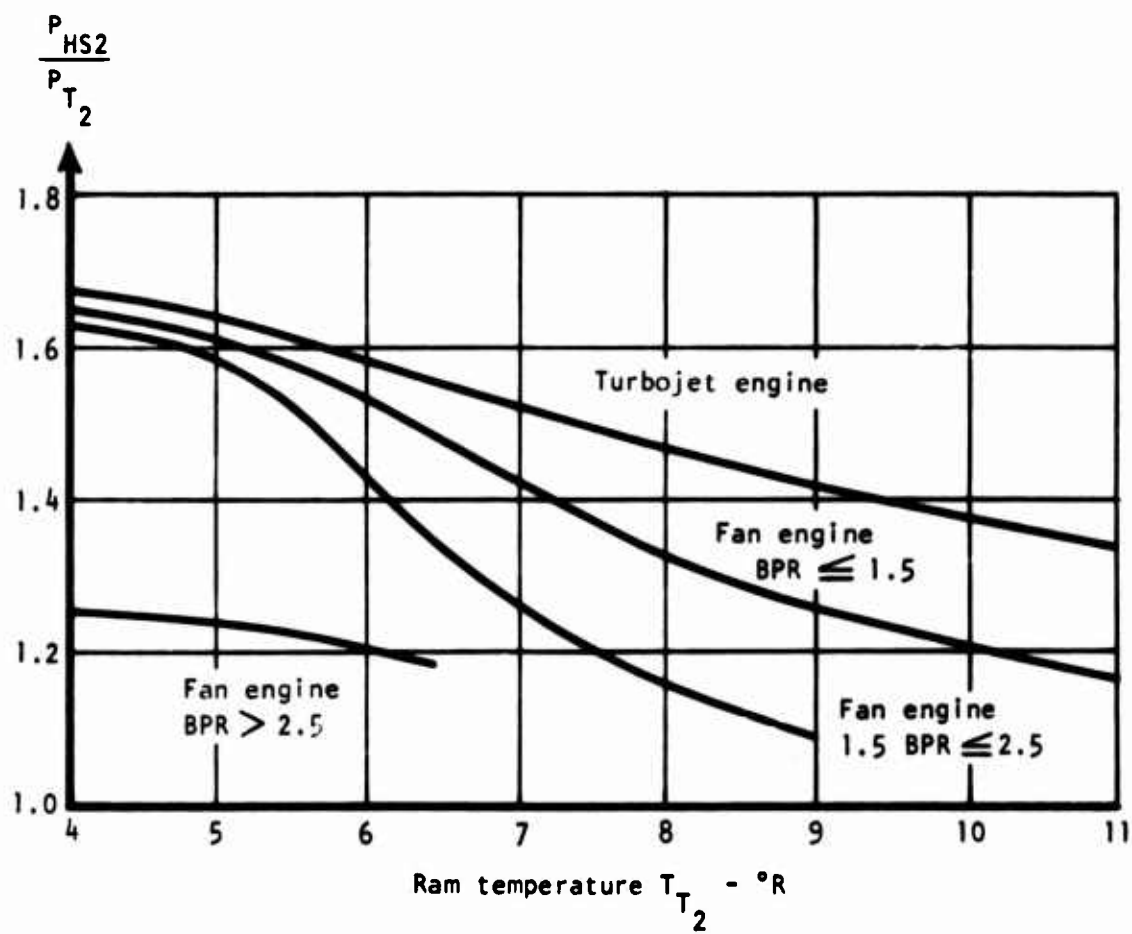


Figure 9. Hammershock pressure ratio.

- Fan engine:  $2.5 < \text{BPR}$

$$P_{HS2}/P_{T2} = 1.538116 - 0.3029697 \left( \frac{T_{T2}}{400} \right) + 0.4872335 \left( \frac{400}{T_{T2}} \right) - 0.4653126 \left( \frac{400}{T_{T2}} \right)^2 \quad (21)$$

As the hammershock moves forward in the inlet duct, experimental trends show an attenuation behind the shock, due to boundary layer-shock interaction, and bleed-off into boundary layer control plenums and bypass exits. Figure 10 shows a curve approximating the attenuation between engine face and inlet throat. Equation 22 is the approximation of this curve that is used in the program.

$$P_{HS1}/P_{HS2} = 0.984 - 0.0074 M_O - 0.0263 M_O^2 \quad (22)$$

### Design Pressures

The following factors are used for converting limit pressure to ultimate design pressure:

- Static pressure at  $M_L$  - 1.5
- Hammershock pressure at  $M_{H1}$  - 1.5
- Hammershock pressure at  $M_L$  - 1.2

These factors are part of the input data set which may be revised for a specific design problem. The reduced safety factor for the transient over-pressure condition, referred to as hammershock, on the  $M_L$  diagram reflects the current design practice. Use of this reduced safety factor reflects the low probability of simultaneous occurrence of the two transient conditions, hammershock pressure and maximum attainable vehicle speed.

### MATERIAL PROPERTIES

Structural synthesis procedures are dependent on the modeling of physical and mechanical properties of the materials selected for structural design.

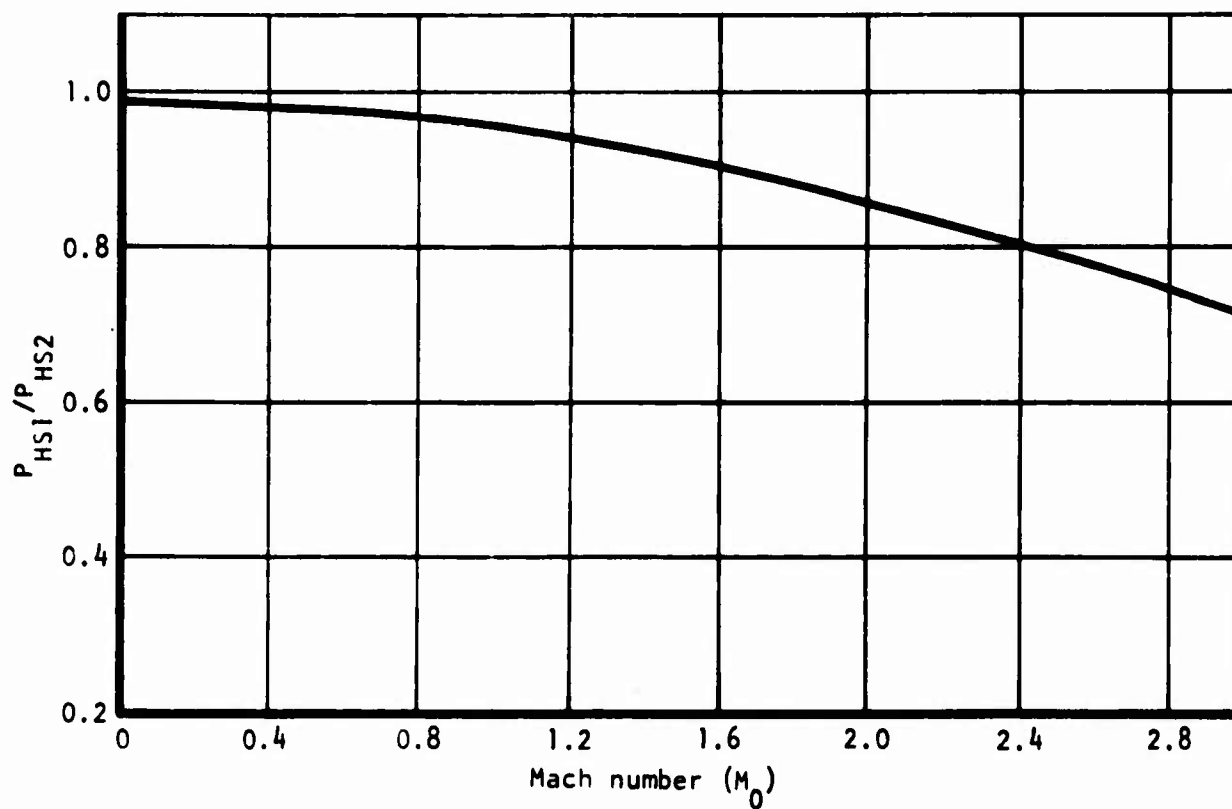


Figure 10. Hammershock attenuation at throat.

Material descriptions must be in a form that can be used to reflect their behavior under load so that structures can be synthesized to satisfy conditions of strength, stiffness, and stability.

Subroutines MCNTL1, MATLF1, and MATLP2 provide these data by processing properties stored in a material data file. This file consists of 20 records which describe physical and mechanical properties of different aluminum, titanium, and steel alloys. Each record consists of the following data:

1. Material identification number and descriptive title
2. Density
3. Modulus of elasticity at room temperature (80° F)
4. Shear modulus of rigidity at room temperature
5. Fatigue characteristic (reduction of area)
6. Stress-strain and strength data at different operating temperatures (a maximum of five sets of data)

Properties at temperatures other than those described in the data sets are determined by an interpolation or extrapolation procedure. Most of these properties are discrete allowables and characteristics.

Inelastic instability solutions require information given by the compressive stress-strain diagram. Stress-strain diagrams of isotropic materials consist of straight-line portions reflecting elastic behavior and curved portions reflecting plastic deformations. Material file data consist of the definition of key points on the stress-strain plot. Proportional limit defines that point on the curve at which the stress-strain diagram departs from the straight line that defines the modulus of elasticity. Figure 11 shows a typical diagram depicting the proportional limit and the yield stress defined by the 0.002 strain offset method. The true yield stress would be used for materials which have a definite yield point. Three other points at equal strain increments define the curved portion of the diagram.

A mathematical representation is used to provide a continuous description of the elastic and plastic properties through the yield stress-point and values for strain, tangent modulus, and secant modulus (Figure 12). The general form of the equation used to approximate the stress-strain curve is:

$$\epsilon = \frac{\sigma}{E} + Ae^{B\sigma} \quad (23)$$

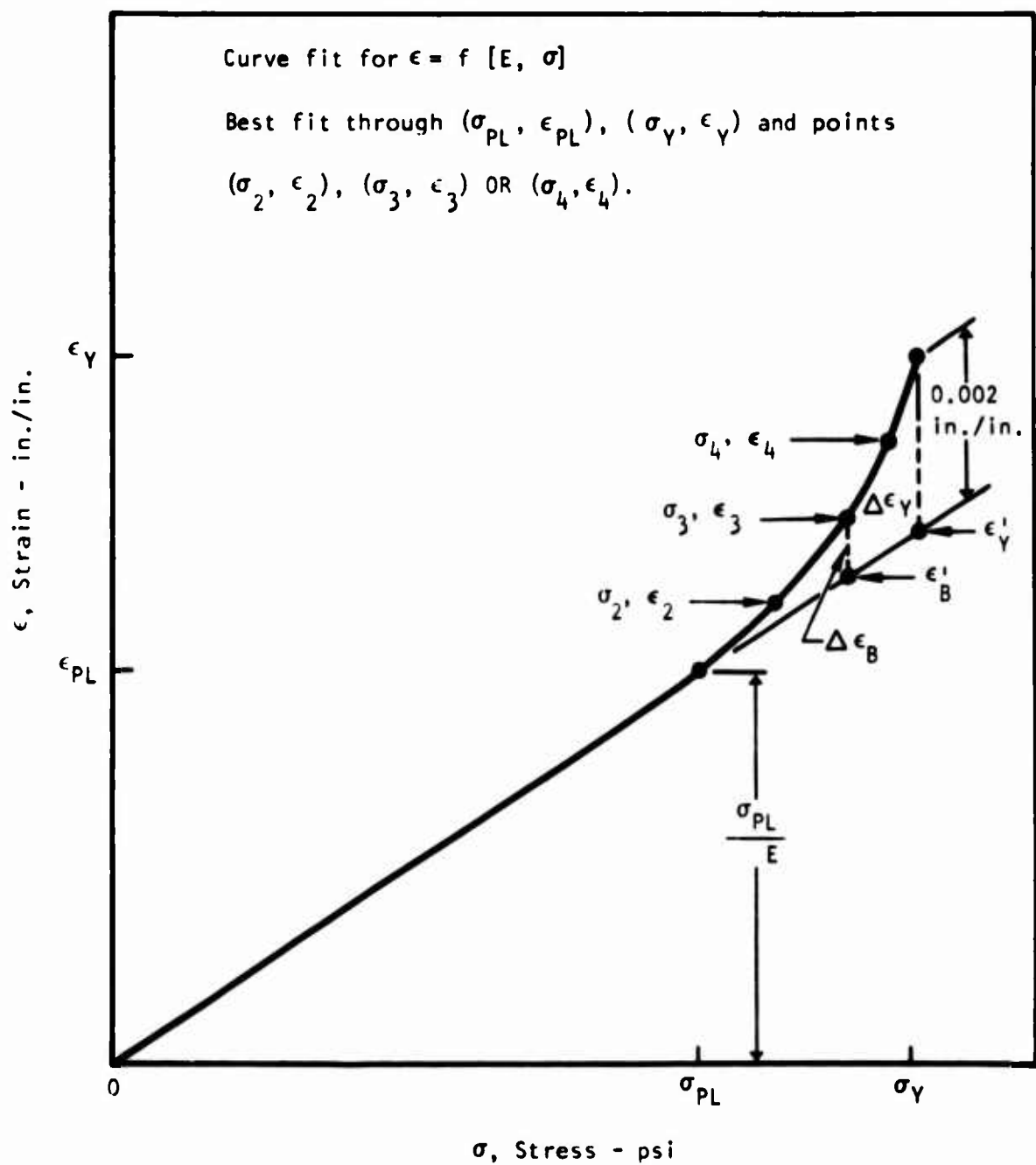


Figure 11. Stress-strain curve and curve fit control points.

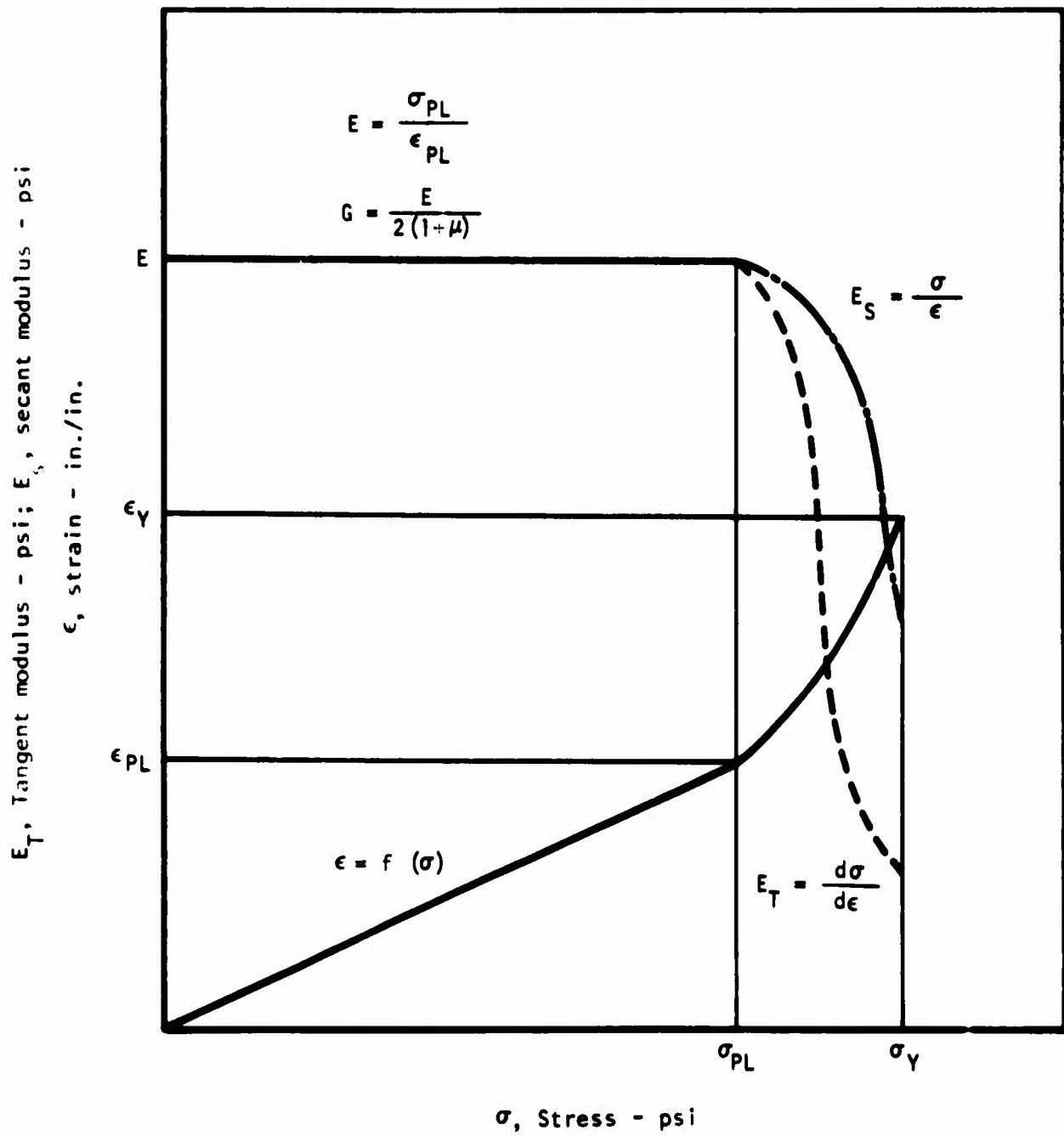


Figure 12. Material stress-strain curve evaluation for elastic and plastic properties.

where

$\epsilon$  = strain, in./in.

$\sigma$  = stress, psi

E = modulus of elasticity, psi

A = constant, function of material, in./in.

B = constant, function of material, 1/psi

e = base of the natural logarithm

The first term of the equation approximates the linear region of the curve where:

$$E = \frac{\sigma_{p1}}{\epsilon_{p1}} = \frac{\sigma_1}{\epsilon_1} \quad (24)$$

The second term fits the plastic region of the stress strain curve. If the curve passes through points 2 and 5, the constant B can be determined by substitution of the stress-strain data.

$$B = \log_e \left[ \frac{\epsilon_5 - \frac{\sigma_5}{E}}{\epsilon_2 - \frac{\sigma_2}{E}} \right] / (\sigma_5 - \sigma_2) \quad (25)$$

and

$$A = \frac{\epsilon_2 - \frac{\sigma_2}{E}}{e^{B\sigma_2}} = e^{\left[ \log_e \left( \epsilon_2 - \frac{\sigma_2}{E} \right) - B\sigma_2 \right]} \quad (26)$$

Similarly, the constants A and B can be derived for curves passing through points 3 and 5 and points 4 and 5. All of the data points are evaluated for the least squares selection. The slope of the curve provides the values of the tangent modulus of the material, the key parameter in stability equations. Tangent modulus is obtained by differentiating the equation.

$$E_T = \frac{d\sigma}{d\epsilon} = \frac{1}{\frac{d\epsilon}{d\sigma}} = \frac{1}{\frac{1}{E} + AB\epsilon^{B-1}\sigma} \quad (27)$$

By definition, tangent modulus is equal to the modulus of elasticity at the proportional limit and, therefore, deviation at this point is also evaluated in the least square fit.

Other design properties obtained from the library are:

1. Poission's ratio
2. Ultimate tensile strength
3. Ultimate shear strength
4. Ultimate bearing strength
5. Fatigue factors, fraction of ultimate tensile strength

Table 2 lists the materials and alloys found in the initial compilation of the material data bank. To allow for ease in identification, each material is identified by record number and descriptive title. This title is always included in the output data set describing the selected structural material for the individual vehicle components being analyzed. This identification of the material used is necessary because material alloy and form, along with the source of the data, must be easily related to the solution of each problem. Data reflecting properties at several operating temperatures after specific exposure at temperatures are included in this file. These properties can be selected when similiar requirements are specified for a problem.

For additional discussion of the manner in which materials properties are established, refer to Volume IV.

TABLE 2. MATERIAL LIBRARY DATA

Material		Density (lb/in. <sup>3</sup> )	Basis <sup>a</sup>	Thickness (in.)	Temperature Range (°F)	Room Temp Properties (psi)	
ID No.	Description					F <sub>Cy</sub>	F <sub>Su</sub>
1	2024-T81 Al clad sheet	0.100	S	0.063-0.250	80	57,000	39,000
2	2024-T851 Al bare plate	0.100	Sb	0.500-1.000	80-300	58,500	38,000
3	2024-T851 Al bare plate	0.100	Sc	1.000-3.000	80-350	54,500	37,500
4	7075-T6 Al clad sheet	0.101	B	0.040-0.062	80	65,000	44,000
5	7075-T6 Al bare plate	0.101	B	0.250-0.500	80	71,000	47,000
6	7075-T6511 Al extrusion	0.101	A	3.000-4.000	80	66,000	45,000
7	7075-T7351 Al bare plate	0.101	S	0.250-0.500	80	56,000	39,000
8	7050-T7351 Al bare plate	0.102	Est	-	80	66,000	42,200
9	2219-T851 Al bare sheet/plate	0.102	Est	0.250-2.000	80	48,000	36,000
10	7178-T6 Al clad sheet	0.102	B	0.045-0.249	80	75,000	48,000
11	7178-T6 Al bare sheet	0.102	Bd	0.045-0.249	80-280	75,000	49,000
12	7079-T651 Al bare plate	0.099	A	0.250-1.500	80	63,000	42,000
13	6Al-4V Ti annealed sheet/plate	0.160	B	-0.250	80-500	138,000	81,000
14	6Al-4V Ti annealed plate	0.160	S	0.187-4.000	80-350	126,000	76,000
15	9Ni-4Co-0.2C steel sheet/plate	0.283	Est	-	80	188,000	118,000
16	17-4PH (H900)	0.282	Est	-	80	165,000	120,000

<sup>a</sup>The basis A, B, and S are as defined in MIL-HDBK-5A.<sup>b</sup>After exposure to 290° F for 120 hours<sup>c</sup>After exposure to 265° F for 390 hours<sup>d</sup>After exposure to 280° F for 120 hours

## INLET DUCTS AND DIFFUSERS

Inlet ducts are designed as pressure vessels consisting of panels which serve as pressure membranes, and frames for maintaining the shape. Duct synthesis and weight estimation are controlled by subroutine DUCTS. This routine controls the estimating procedure by calling the following geometry, design synthesis, and weight calculation routines:

- DCTGEO Calculates duct contour data at duct cut stations, and surface area and length for segments bounded by cuts.
- FRMND3 Calculates frame synthesis cut coordinates at each duct cut station. Frame synthesis cut coordinates are based on equal segment lengths.
- FRMELD Calculates unit internal loads at frame segments.
- DUCPNL Calculates duct panel sizing at specified duct cut and frame spacing.
- DUCFRM Calculates sizing and weight of a single duct frame at specified duct cut and frame spacing.
- DUCWET Calculates duct panel structure weight.

Subroutine DUCTS controls a frame spacing search procedure at each of the duct cut stations. The search is conducted between predefined minimum and maximum spacing. Spacing search starts at the minimum and proceeds at fixed spacing increments until the lumped weight of panels and frames indicates an upward trend. Increase of weight with increase in spacing or an optimum less than the initial spacing abbreviates the search. A final sizing pass is made at the spacing prior to the upward trend. Spacings are evaluated at fixed increments such that the derived optimum spacing could be in error by a maximum of half the increment. Weight-spacing variations are, in general, flat in the region of practical design limits such that a more precise solution is not consistent with the scope of this program. If required, spacing increment may be decreased by the user to obtain refined solutions. Controls are also provided such that frame spacing may be restricted to a user-determined input value.

Since all geometric constraints are established by DUCTS, synthesis routines FRMND3, FRMELD, DUCPNL, and DUCFRM are configured for point design solutions. Methods of analysis used to develop duct structure weight are presented in the following paragraphs.

## DUCT GEOMETRY

Duct cross-section geometry is defined at as many as 10 duct stations starting at the inlet lip, and ending at the front face of the engine. A one-dimensional leading edge is described by the single dimension; the next duct cut station describes the first section at which the duct is continuous.

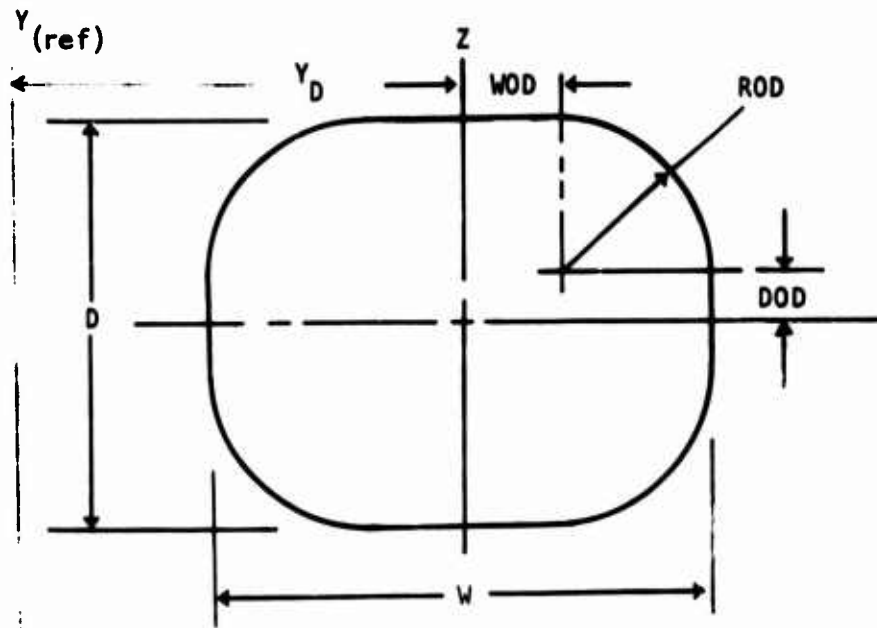
Ducts on a vehicle are assumed to be identical in shape, such that the description of a single duct is sufficient. The presence of bifurcated inlets on most current fighters which combine to form a single duct at a point forward of the engine face is defined by description of the lateral coordinate of the duct centerline relative to the nacelle center line for podded-engine concepts, or the lateral coordinate relative to the fuselage centerline on buried-engine concepts. A lateral nonzero coordinate defines the presence of two ducts per nacelle or fuselage, while zero indicates the presence of a single duct. Thus, if synthesis cuts are spaced close together at the juncture, one defining the geometry immediately forward, and the other the geometry immediately aft of the transition, the program is provided with sufficient logic to make the rational evaluation.

Duct contour data at duct synthesis stations are calculated in subroutine GEOMF1. Calculations in this routine determine shape parameters and perimeter at synthesis stations. Segment data calculated in this routine consists of length and surface area.

Section geometry calculations are based on a family of shapes that may be defined by straight lines and circular arcs. A sketch of the general shape and parameters at a cut follows.

Either of two input formats may be used to define the geometry at the duct cuts (X0):

1. Width (W), depth (D), lateral centroid ( $Y_D$ ), and perimeter (P)
2. Width (W), depth (D), lateral centroid ( $Y_D$ ), and perimeter correlation factor ( $K_c$ )



If the perimeter is not readily available, perimeter correction factor ( $K_c$ ) may be used to describe the shape. Figure 13 depicts the significance of  $K_c$ . The family of rounded rectangle shapes is defined within the region bounded by the curves for rectangular, vertical oval, and horizontal oval shapes. The intersection point of the curves for horizontal and vertical ovals represents a circular cross section. The perimeter is defined by the relationship.

$$P = K_c \frac{\pi}{2} (D + W) \quad (28)$$

where

$K_c = 1.0$  indicates a circular shape

$K_c = 1.273$  indicates a rectangular shape

The perimeter is defined as:

$$P = 4 (DOD + WOD) + 2\pi ROD \quad (29)$$

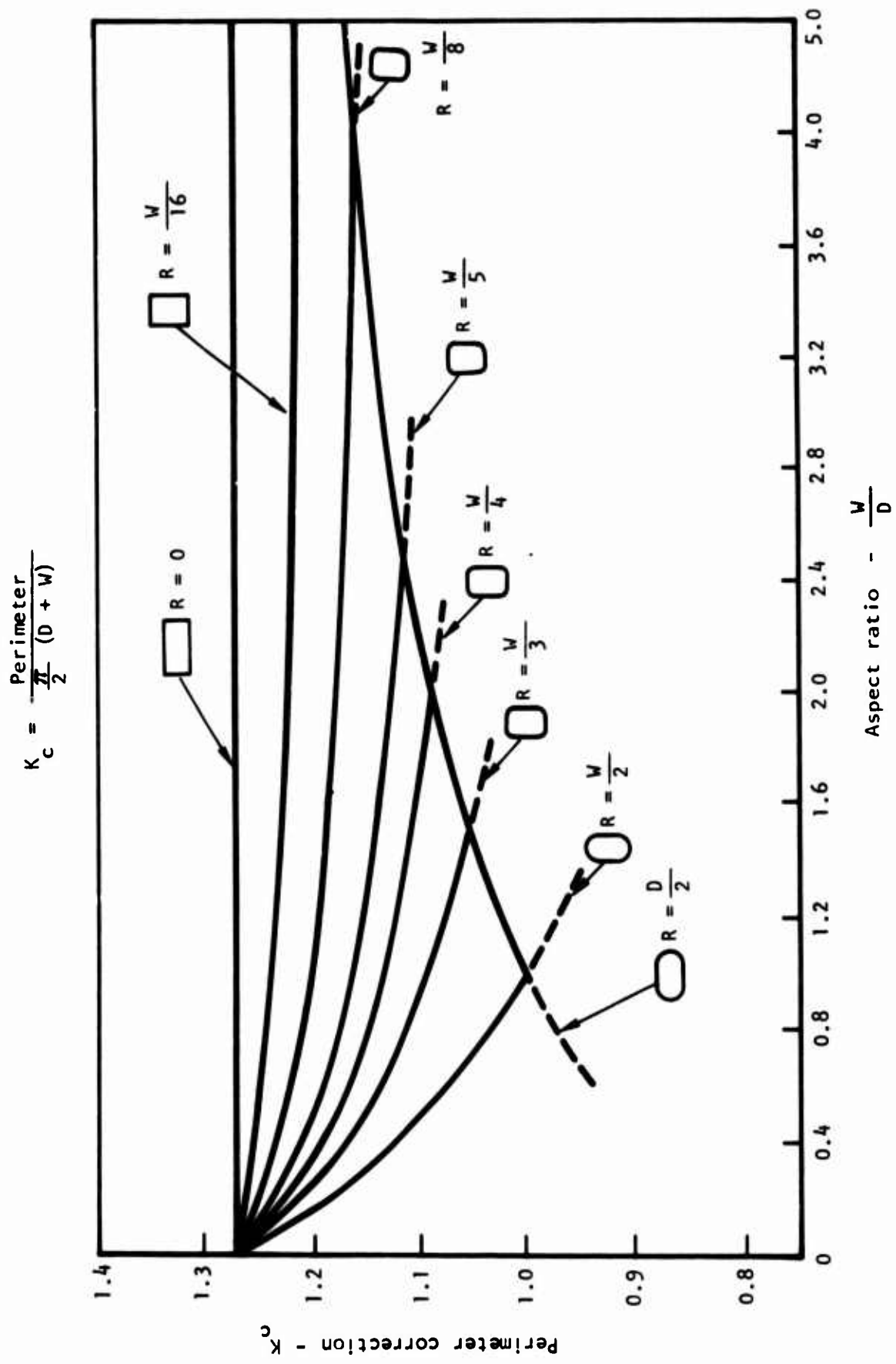


Figure 13. Programmed shapes and correction factors.

and

$$WOD = (W - 2ROD)/2 \quad (30)$$

$$DOD = (D - 2ROD)/2 \quad (31)$$

substituting and solving for the corner radius:

$$ROD = \frac{2D + 2W - P}{8 - 2\pi} \quad (32)$$

If the input parameters result in  $ROD < 0$  or  $2ROD > W$  or  $D$ , the perimeter is maintained and the parameters  $ROD$ ,  $DOD$ , and  $WOD$  are adjusted by a factor  $K$ .

If  $ROD < 0$ , the shape is adjusted to represent a rectangle in the following manner:

$$ROD = 0 \quad (33)$$

$$P = K (2D + 2W) \quad (34)$$

$$K = \frac{P}{2D + 2W} \quad (35)$$

If  $2ROD > W$  or  $D$ , the shape is adjusted to represent a horizontal or vertical oval in the following manner:

$$ROD = \text{minimum of } W/2 \text{ or } D/2 \quad (36)$$

$$X = \text{maximum of } W \text{ or } D \quad (37)$$

$$PER = K (2\pi ROD + 2 (X - 2ROD)) \quad (38)$$

$$K = \frac{P}{2\pi ROD + 2 (X - 2ROD)} \quad (39)$$

Then the adjusted values for DOD, WOD, and ROD are:

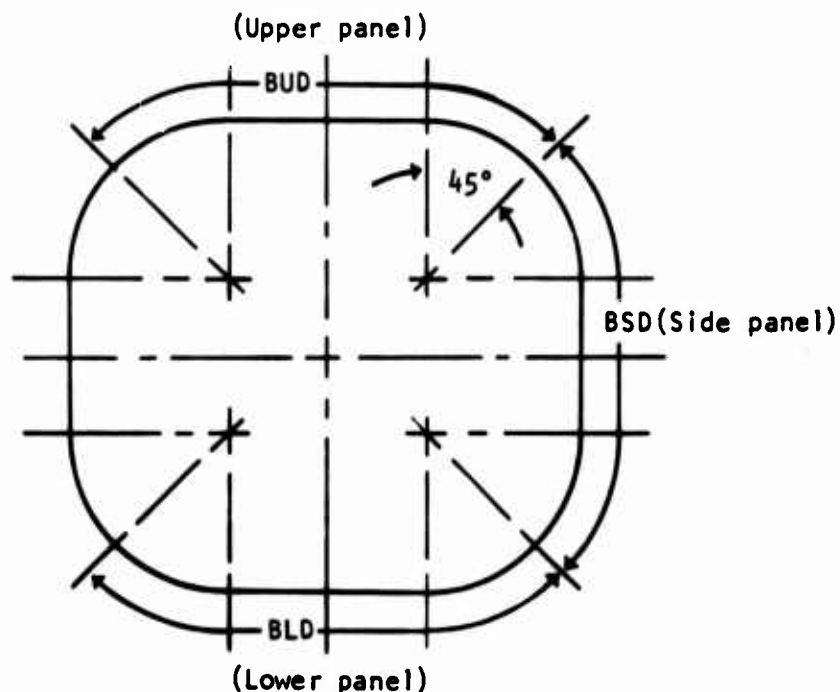
$$WOD = K (W - 2ROD)/2 \quad (40)$$

$$DOD = K (D - 2 ROD)/2 \quad (41)$$

$$ROD = K (ROD) \quad (42)$$

Should the geometry require adjustment by "K," a warning message is printed to indicate the amount of adjustment made to the depth and width at the section.

At each cut station, duct panels are divided into four sectors representing the upper, lower, and two sides. A 45-degree angle is used to define the limits of these sectors.



The peripheral length of the cover elements in these sectors are:

$$BUD = BLD = 2WOD + \frac{\pi}{2} ROD \quad (43)$$

$$BSD = 2DOD + \frac{\pi}{2} ROD \quad (44)$$

Segment geometric data are calculated from the cut data. The subscript  $n$  is used in the discussion that follows to denote the segment bounded by cuts  $j-1$  and  $j$ . Segment length (DLXD) is determined by taking the difference between adjacent cuts. Surface area (SFD) is calculated by using the average perimeter (equation 45):

$$SFD_n = DLXD_n (P_j + P_{j-1})/2 \quad (45)$$

A one-dimensional leading edge is described by the single dimension; the next synthesis cut describes the first section at which the duct is continuous. One-dimensional leading edge surface area and centroid are determined from geometric data at the first two cuts. For vertical leading edges, there are two possibilities; a third case, although improbable, is also programmed.

Case where lateral coordinates ( $Y_D$ ) at stations 1 and 2 are both positive:

$$SFD_1 = DLXD_1 (D_1 + BSD_2 + BUD_2 + BLD_2) \quad (46)$$

where

$SFD_1$  = duct lip surface area

$DLXD_1$  = leading edge segment length

$D_1$  = depth at station 1

$BSD_2$  = peripheral length of duct side sector at station 2

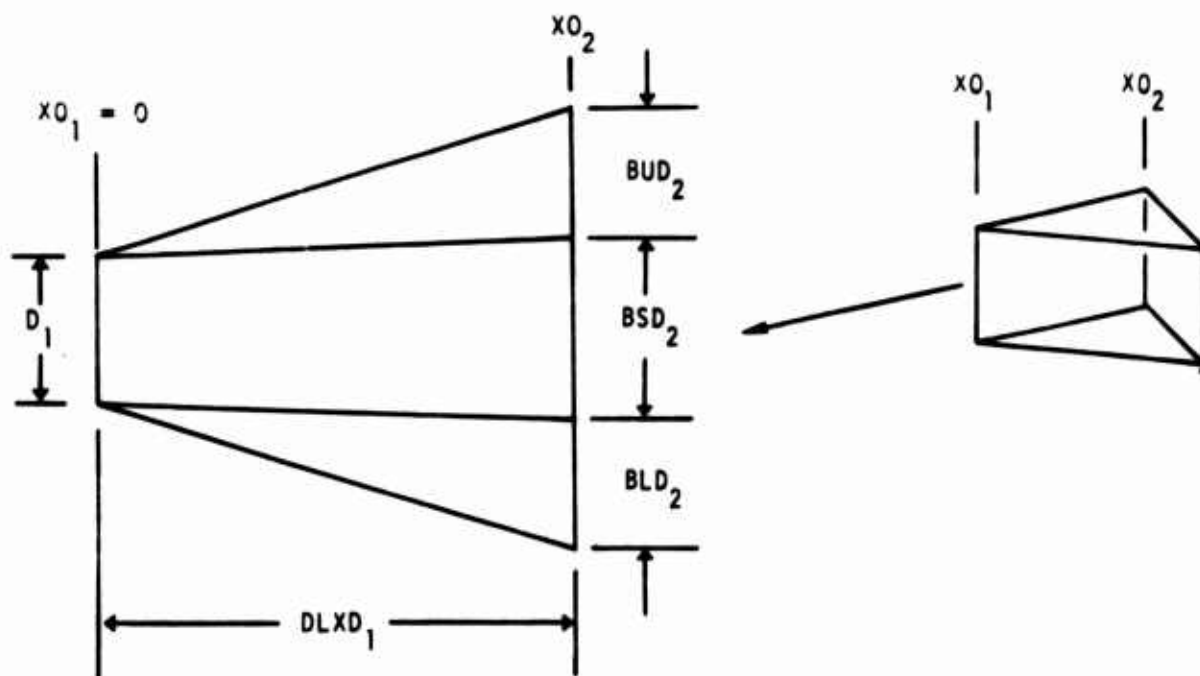
$BUD_2$  = peripheral length of duct upper sector at station 2

$BLD_2$  = peripheral length of duct lower sector at station 2

The foregoing calculation accounts for two separated inlets as would occur for fuselage-buried-engine concepts with side inlets. A flat pattern representation of one of these inlet surfaces follows.

Case where lateral coordinate at station 1 is zero and at station 2 is positive:

$$SFD_1 = DLXD_1 \left\{ \left( \frac{D_1 + BSD_2}{2} \right) + BUD_2 + BLD_2 \right\} \quad (47)$$



Equation 47 represents the case where there are two inlets per nacelle or, on fuselage-buried engine concepts, two inlets with a common vertical splitter.

Case where lateral coordinate at stations 1 and 2 are both zero:

$$SFD_1 = \frac{DLXD_1}{2} (D_1 + BSD_2 + BUD_2 + BLD_2) \quad (48)$$

For horizontal leading edges, there are two possibilities. Case where the lateral coordinate at station 2 is zero is calculated by equation 49. This situation represents a single inlet per nacelle or fuselage.

$$SFD_1 = \frac{DLXD_1}{2} (W_1 + BUD_2 + 2 BSD_2) \quad (49)$$

where

$W_1$  = width of inlet lip at station 1

The case where the lateral coordinate at station 2 is positive represents two inlets per nacelle or fuselage and is calculated by equation 50.

$$SFD_1 = DLXD_1 \left( W_1 + BUD_2 + \frac{3}{2} BSD_2 \right) \quad (50)$$

## DUCT PANEL SYNTHESIS

Duct panel thickness requirements at continuous duct sections are calculated in subroutine DUCPNL. The synthesis approach assumes that the internal pressure is beamed to the frames by the combined bending and diaphragming action of the cover panels.

### Strength and Deflection Equations

Strip theory is used to evaluate the combined bending diaphragm action. The maximum cover stress occurs at the supports. The bending moment is maximum at the edges, goes through an inflection point, and is smaller at the midspan. Combined bending and diaphragm action result in the second highest stresses occurring at the midspan. Therefore, single-thickness covers are design by the stress at the edges. Land thickness for milled cover panels is determined by the edge stress, and the field thickness is determined by the stress at the midspan. The analytical solutions are expressed by numerical values of dimensionless coefficients in Reference 4. This same information is presented as curves in the Royal Aeronautical Society notes. The log-log plot of these curves (Figure 14) suggests a numerical approximation. The derivation of thickness as an explicit function of these variables is obtained by a curve fit approach.

The curve fit approximation at the edge of the panel is:

$$\frac{\sigma}{E} \left( \frac{b}{t} \right)^2 \approx 1.4725 \left[ \frac{P}{E} \left( \frac{b}{t} \right)^4 \right]^{0.69412}$$

or

$$t = \frac{1.646 b P^{0.894} E^{0.394}}{\sigma^{1.288}} \quad (51)$$

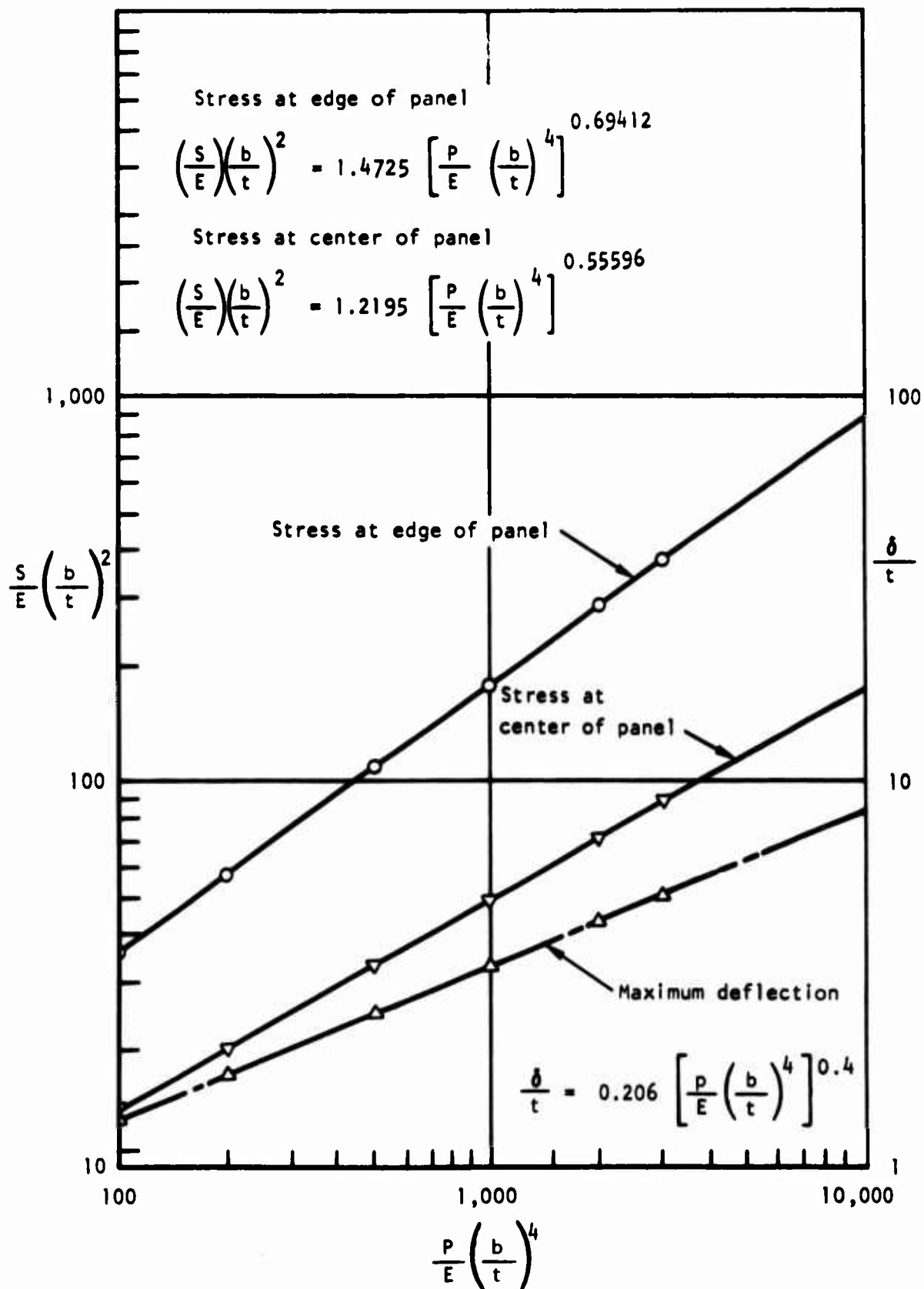


Figure 14. Diaphragm stresses and deflections.

where

$t$  = panel thickness, in.

$b$  = frame spacing, in.

$P$  = limit duct pressure, psig

$E$  = duct material modulus of elasticity, psi

$\sigma$  = duct material limit allowable tensile stress, psi

The midspan thickness and deflections are:

$$\frac{\sigma}{E} \left( \frac{b}{t} \right)^2 = 1.2195 \left[ \frac{P}{E} \left( \frac{b}{t} \right)^4 \right]^{0.55596}$$

or

$$t = \frac{1.3769 b P^{2.484}}{\sigma^{4.467} E^{1.984}} \quad (52)$$

and

$$\frac{\delta}{t} = 0.206 \left[ \frac{P}{E} \left( \frac{b}{t} \right)^4 \right]^{0.4}$$

or

$$t = \frac{0.071853 \left( \frac{P}{E} \right)^{2/3} b^{8/3}}{\delta^{5/3}} \quad (53)$$

where

$\delta$  = allowable panel deflection, in.

In the foregoing equations, stress and pressure are expressed in terms of limit rather than ultimate design. This is a normal design practice when internal loads are dependent on deflected shape.

Equations 51, 52, and 53 are used in a systematic check of strength and deflection requirements for pressures at the nine speed profile points. Minimum gage and, for milled panel designs, an additional constraint of maximum allowable ratio of land thickness to field thickness are also evaluated to determine the duct sizing.

### Allowable Stress

Allowable limit stress is obtained by evaluating ultimate strength and allowable stress under cyclic loading. Previously discussed safety factors are reiterated as follows:

- Static pressure at  $M_L$  - 1.5
- Hammershock pressure at  $M_H$  - 1.5
- Hammershock pressure at  $M_L$  - 1.2

Limit allowable tensile stress is obtained by dividing the duct material ultimate tensile strength at the pressure condition temperature by the appropriate safety factor.

Inlet pressures are cyclic occurrences that subject the duct to possible fatigue failure. The maximum allowable stress to prevent fatigue failure is a preprogrammed fraction (0.5) of the material ultimate tensile strength. Limit allowable stress corresponding to static pressure on the  $M_L$  profile is the lower of either that which satisfies strength or fatigue. Hammershock pressures are only investigated for strength requirements.

### Allowable Deflection

Duct panel deflection is evaluated for static pressures on the  $M_L$  profile. Allowable deflection constraints are predefined nondimensional parameters based on frame spacing in the form of  $\delta/b$ . This predefined allowable deflection forward of the throat is 0.03 inch per inch and is 0.06 from the throat to the engine face. Difference between these two values is attributed to flow field disturbance being detrimental to inlet performance at the throat and less so upon expansion of the air aft of the throat. If available, user input data can be used to override these deflection constraints.

## Duct Weight

Duct weight calculations are performed in subroutine DUCWET. The procedure consists of evaluating a one-dimensional leading edge segment, normal continuous cross-section duct segments, and segments blanked by the presence of two-dimensional variable geometry ramps.

The leading edge segment, should it occur, is assumed to consist of structure forward of the first complete cross-section defined at the second duct cut. This leading edge segment is estimated at 4 pounds per square foot of surface area.

Weight calculation for the remainder of the inlet duct panels is based on a linear taper of thickness between duct cuts. Should two-dimensional ramps exist, areas blanked by ramps are not required and, therefore, are deleted in the weight calculation.

A weight correlation factor is applied to the resultant weight. This factor is considered to be a calibration factor which accounts for design parameters and unique conditions not considered in the analysis.

## DUCT FRAME SYNTHESIS

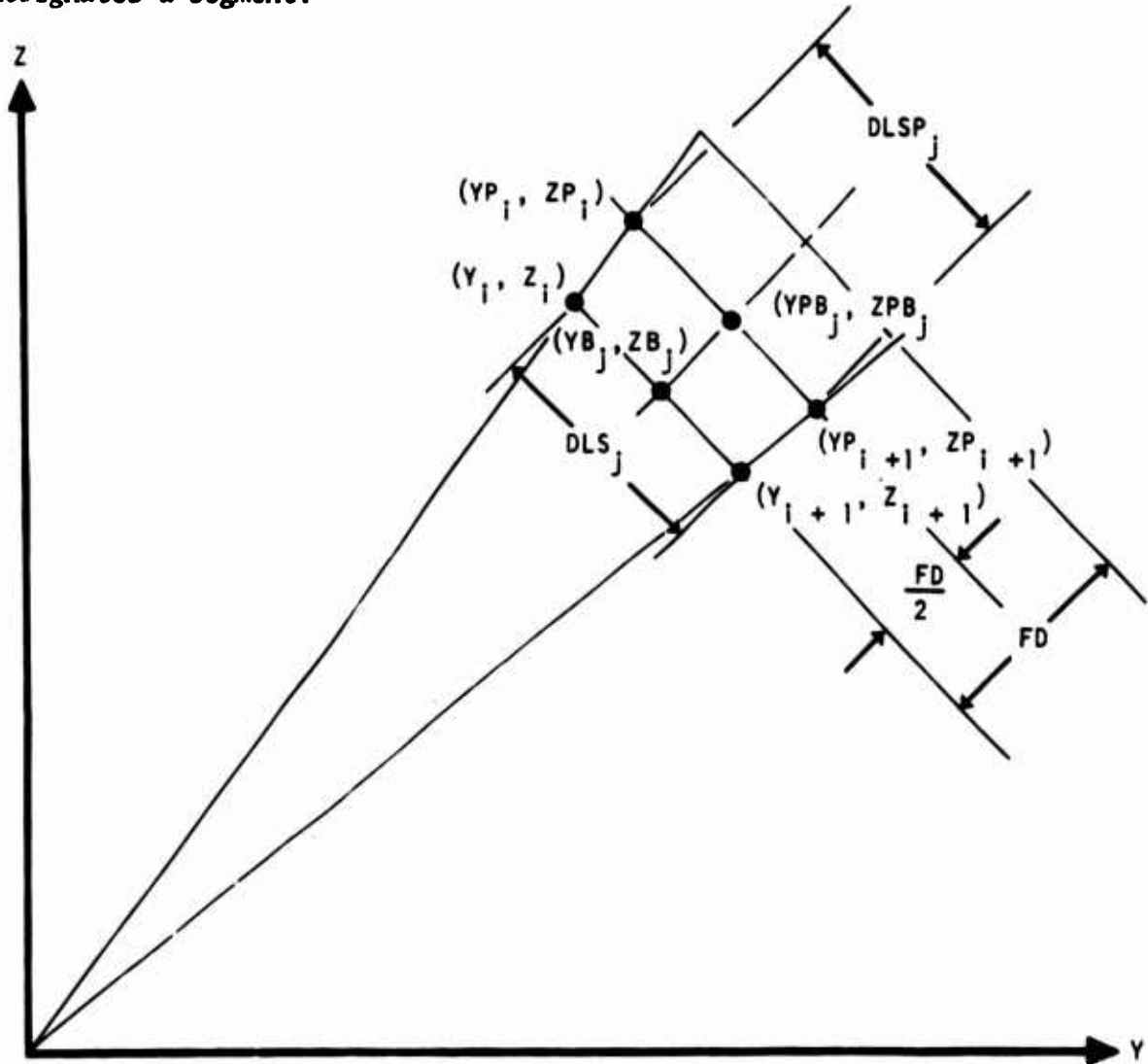
Duct frames are synthesized at duct cut stations with continuous duct sections. Pressure acts at the duct surface and is reacted by a frame with a neutral axis half a frame depth outside the duct lines. Pressure reacted by the frame is defined as the loading due to pressure times frame spacing.

The elastic center method<sup>(5)</sup> is used to derive internal loads at as many as 60 frame segments. In this approach, ring distortions due to axial and shear forces are neglected, based on the premise that these distortions are small compared to bending distortions. Iteration on internal loads, sizing, and flexibility are not included in this approach. Iteration cycles have been omitted to minimize computer execution time. Another economic consideration is the judicious use of the number of frame segments. Although the capability for evaluating 60 frame segments has been programmed, the evaluation of 20 synthesis segments should provide reasonable accuracy.

## Frame Geometry

Frame inner cap coordinates at a duct cut station are calculated in subroutine FRMND3. Duct contour data are used to calculate these coordinates. Cuts are located to provide segments of equal length (DLS) with the first and last cuts at the top centerline of the frame. Since frame structure extends

outside the duct mold line, neutral axis coordinates are then calculated in FRMELD by projecting outward a distance equal to half the frame depth. In the following sketch and discussions, the subscript  $i$  designates a cut, and  $j$  designates a segment.

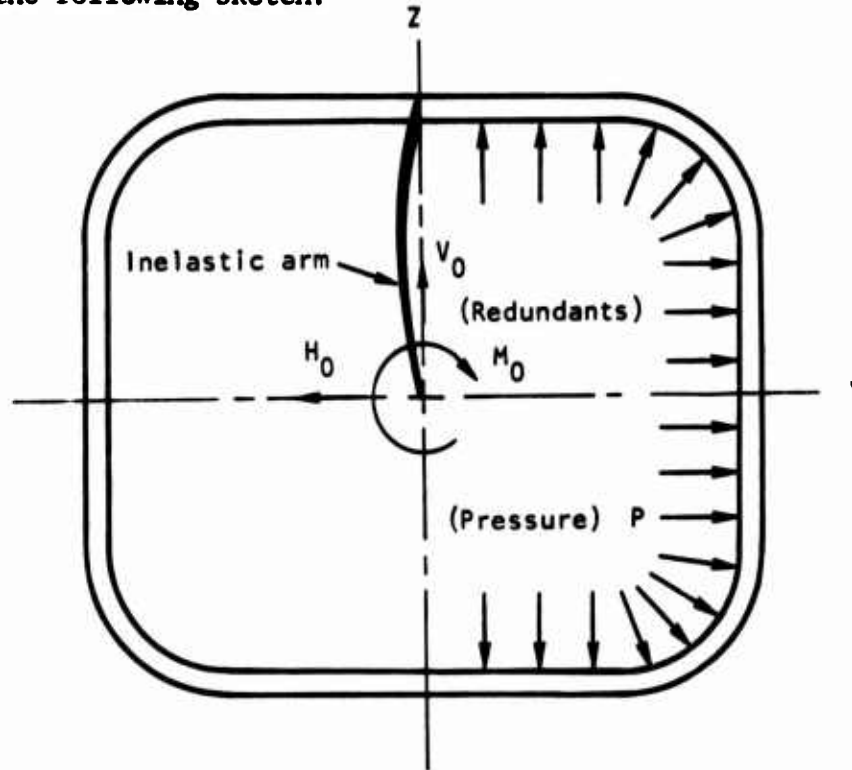


Perimeter of the outer cap, ( $P$ ), and perimeter of the frame, ( $PP$ ), are calculated by the following summations.

$$P = \sum DLS_j \quad (54)$$

$$PP = \sum DLSP_j \quad (55)$$

For most duct frames, the Z-axis is the axis of symmetry for both ring geometry and flexibility. Therefore, the rigid arm in the elastic center method is assumed to be attached to the top centerline of the ring. The positive sign convention and location of redundants and pressure forces are shown in the following sketch.



Since one of the assumptions is that frame flexibility is constant, unity may be used for stiffness ( $I_j$ ), and the elastic center and the geometric neutral axis are identical. The elastic center (ZZS) is determined by:

$$ZZS = \frac{\sum \frac{ZPB_j DLSP_j}{I_j}}{\sum \frac{DLSP_j}{I_j}} = \frac{\sum ZB_j DLS_j}{\sum DLS_j} \quad (56)$$

The section inertia about the two reference axes are:

$$IOZ = \sum YPB_j^2 DLSP_j \quad (57)$$

$$IOY = \sum (ZPB_j - ZZS)^2 DLSP_j \quad (58)$$

### Unit Internal Frame Loads

Since pressure acts normal to the inner cap surface and is uniform around the section, internal loads for any frame shape can be determined on the basis of unit pressure loading. Unit internal loads, when multiplied by the design pressure provide the design loads. Subroutine FRMELD calculates these unit internal loads. Dimension of the unit pressure load, (p), is 1.0 lb/in. in the equations and discussions that follow.

Static frame moment, vertical, and horizontal loads are determined by combining effects of the unit pressure forces. Static moment at any cut is calculated by equation 59.

$$BM_i = P \sum_{n=2}^i (Z_n - Z_{n-1})(ZP_i - ZB_{n-1}) + (Y_n - Y_{n-1})(YP_i - YB_{n-1}) \quad (59)$$

Static vertical force at any cut is calculated by equation 60.

$$V_i = P \sum_{n=2}^i (Y_n - Y_{n-1}) \quad (60)$$

Static horizontal force at any cut is calculated by equation 61.

$$A_i = P \sum_{n=2}^i (Z_n - Z_{n-1}) \quad (61)$$

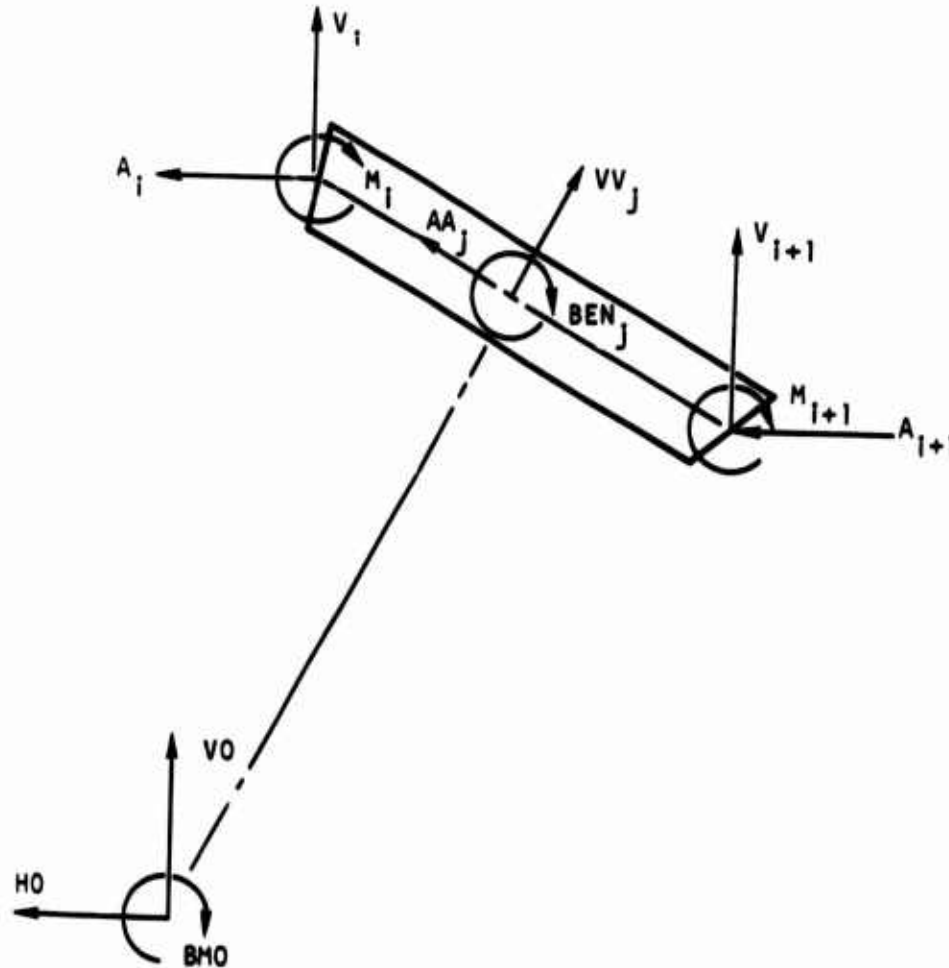
Due to ring symmetry about the Z-axis, the redundants at the elastic center are calculated by the three independent equations. These equations are further simplified by the assumption that ring flexibility (EI) is constant.

$$BMO = - \frac{\sum \frac{M \text{ DLSP}}{EI}}{\sum \frac{\text{DLSP}}{EI}} = - \frac{\sum M \text{ DLSP}}{PP} \quad (62)$$

$$H_O = - \frac{\sum \frac{M (Z_{PB} - Z_{ZS}) DLSP}{EI}}{\sum \frac{(Z_{PB} - Z_{ZS})^2 DLSP}{EI}} = - \frac{\sum M (Z_{PB} - Z_{ZS}) DLSP}{I_{OY}} \quad (63)$$

$$V_O = - \frac{\sum \frac{M Y_{PB} DLSP}{EI}}{\sum \frac{Y_{PB}^2 DLSP}{EI}} = - \frac{\sum M Y_{PB} DLSP}{I_{OZ}} \quad (64)$$

The unit internal ring bending moment, shear, and axial loads at any segment are obtained by taking the average of the loads at bounding cuts and the loads due to the redundants.



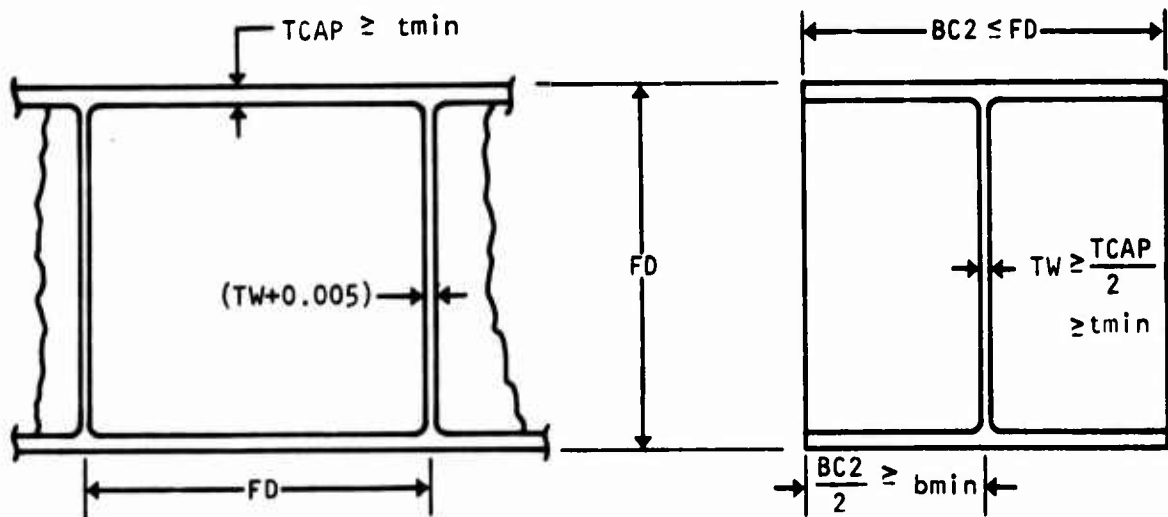
$$BEN_j = BMO + VO YPB_j + HO (ZPB_j - ZZS) + \left( \frac{M_i + M_{i+1}}{2} \right) \quad (65)$$

$$W_j = \frac{\left[ VO + \left( \frac{V_i + V_{i+1}}{2} \right) \right] (Y_{i+1} - Y_i) + \left[ HO + \left( \frac{A_i + A_{i+1}}{2} \right) \right] (Z_{i+1} - Z_i)}{DLS_j} \quad (66)$$

$$AA_j = \frac{\left[ VO + \left( \frac{V_i + V_{i+1}}{2} \right) \right] (Z_{i+1} - Z_i) + \left[ HO + \left( \frac{A_i + A_{i+1}}{2} \right) \right] (Y_{i+1} - Y_i)}{DLS_j} \quad (67)$$

### Frame Synthesis and Weight

Duct frame synthesis and weight calculations are performed in subroutine DUCFRM. The sizing approach assumes shear resistant webs with the caps determined by material allowable and flange crippling. Frame stiffeners are assumed to be one gage greater than the web gage. The structure model and geometric constraints are shown in the following sketch.



Frame segments are sized for hammershock pressures on the  $M_H$  and  $M_L$  profiles and for static pressures on the  $M_L$  profile. Sizing for each pressure condition is compared with minimums and sizing that satisfied all previous pressure conditions. Since each condition may be at a different structure design temperature, material properties at the appropriate condition are used. Ultimate loading on the frame is determined by equation 68.

$$w = W b FS \quad (68)$$

where

$w$  = frame loading, lb/in.

$W$  = limit gage pressure, psig

$b$  = frame spacing, in.

$FS$  = factor of safety:

- 1.5 for static pressure at  $M_L$
- 1.5 for hammershock pressure at  $M_H$
- 1.2 for hammershock pressure at  $M_L$

The limit gage pressure ( $W$ ) at the duct cut station is obtained by interpolating between pressures at the throat and at the engine face. Maximum cap load at a frame segment ( $j$ ) is obtained by equation 69.

$$FA_j = w \left( \left| \frac{BEN_j}{FD} \right| + \left| \frac{AA_j}{2} \right| \right) \quad (69)$$

where

$FA_j$  = cap load, lb

$BEN_j$  = unit internal bending moment, in.-lb/(lb/in.)

$FD$  = frame depth, in.

$AA_j$  = unit internal axial load, lb/(lb/in.)

Cap area that satisfies strength is

$$A_c = \frac{F A_i}{K F_{cy}} \quad (70)$$

where

$A_c$  = cap area, in.<sup>2</sup>

$K$  = reduction factor on allowable stress (0.9)

$F_{cy}$  = frame material compression yield stress, psi

Flange crippling allowable is

$$F_{CCR} = \frac{K_c \pi^2 E}{12 (1-\mu^2)} \left( \frac{2 TCAP}{BC2} \right)^2 \quad (71)$$

where

$K_c$  = flange crippling coefficient (0.426)

Equating strength and crippling stress and solving for cap thickness,

$$K F_{cy} = F_{CCR} \frac{K_c \pi^2 E}{12 (1-\mu^2)} \left( \frac{2 TCAP}{BC2} \right)^2 \quad (72)$$

$$\frac{2 TCAP}{BC2} = \sqrt{\frac{K F_{cy} 12 (1-\mu^2)}{K_c \pi^2 E}} \quad (73)$$

$$TCAP = \sqrt{\frac{A_c}{2}} \sqrt{\frac{K F_{cy} 12 (1-\mu^2)}{K_c \pi^2 E}} \quad (74)$$

Web shear strength is

$$F_{su} = \frac{w |W_j|}{FD TW} \quad (75)$$

where

$F_{su}$  = frame material ultimate shear strength, psi

$W_j$  = unit internal shear, lb/(lb/in.)

Making the web shear resistant and equating shear stress and crippling stress, the web thickness is

$$F_{SCR} = \frac{K_s \pi^2 E}{12(1-\mu^2)} \left(\frac{TW}{FD}\right)^2 = \frac{w |W_j|}{FD TW} \quad (76)$$

where

$K_s$  = shear crippling coefficient (7.5)

$$TW = \left( \frac{w |W_j| FD 12 (1-\mu^2)}{K_s \pi^2 E} \right)^{1/3} \quad (77)$$

The final web thickness is the maximum of that required for shear resistance, shear strength, or half the cap thickness.

After all load conditions have been evaluated, the frame weight is calculated by the summation of cap web and stiffener volume.

$$TWT = \sum \left[ BB2_j (TWW_j + 0.005) + TCC_j 2 BB2_j + \right. \\ \left. TWW_j FD \right] DLSP_j RHO \quad (78)$$

where

TWT = weight of one frame at duct cut station, in.

BB2<sub>j</sub> = BC2, cap width at a frame segment, in.

TWW<sub>j</sub> = TW, web thickness at a frame segment, in.

TCC<sub>j</sub> = TCAP, cap thickness at a frame segment, in.

RHO = frame material density, lb/in.<sup>3</sup>

#### TWO-DIMENSIONAL VARIABLE-GEOMETRY RAMPS

Variable geometry ramp structures are designed by differential pressures between the inlet and the plenum compartment behind the ramps. The critical design pressure condition is determined in subroutine JECRT by investigating hammer shock pressures at points on the vehicle speed-altitude profile. Synthesis and weight calculations for two-, three-, and four-ramp variable-geometry systems are performed in subroutine RAMPS. Procedures in RAMPS consist of:

1. Calculation of design pressure differentials for each ramp panel
2. Calculation of local reactions based on equations of static equilibrium and component design loads
3. Structural synthesis based on loads and construction
4. Tests against minimum practical structure

## RAMP DESIGN PRESSURE

Hammershock pressure at each of nine points on both the level flight maximum speed and limit speed envelopes are investigated for critical ramp design pressure. Subroutine PRECRT selects the critical pressure for use by the variable-geometry ramp synthesis routine, RAMPS.

On two-dimensional variable-geometry inlet systems, boundary layer is bled through the ramps into plenum compartments located behind the ramps. In order to minimize ramp weights, plenum pressures are maintained as close as possible to the average of buzz and hammershock, but at a level which maintains a positive pressure differential between the inlet and plenum for steady-state conditions. The structural design condition for the ramps is assumed to occur during a hammershock condition when the pressure differential is presumed to be at its maximum level.

Different safety factors are used to convert limit pressure to ultimate design pressure. The rationale behind use of these factors has been presented in the paragraphs discussing pressure derivation. These safety factors (FACT) are as follows:

- Hammershock pressure at  $M_H - 1.5$
- Hammershock pressure at  $M_L - 1.2$

Structure temperature and corresponding material properties vary with pressure condition. The procedure for selecting design pressure evaluates these parameters. At each pressure condition, the ratio (PHS/FCY) of ultimate hammershock pressure to compression yield strength is calculated. Values of this ratio are compared for all conditions, and the parameters attendant with the largest value of this ratio are selected for ramp design. Following are parameters selected at the design pressure condition:

PHS = ultimate absolute design hammershock pressure, lb/in.<sup>2</sup>  
FCY = ramp material compression yield stress, lb/in.<sup>2</sup>  
FSU = ramp material ultimate shear strength, lb/in.<sup>2</sup>  
DENS = ramp material density, lb/in.<sup>3</sup>  
XMAT = material type identification

- 1 = aluminum
- 2 = titanium
- 3 = steel

The user has the option of inputting the foregoing design pressure condition data. Input of these data precludes the execution of PRECRT.

These design pressure parameters define the absolute inlet pressure condition. Since data pertaining to plenum and ramp bleed are normally not available in the preliminary design phase, ramp pressure differentials are estimated as fractions of the ultimate hammer shock pressure. Estimated percentages are used in the ramp synthesis routine, RAMPS, to calculate local design pressure differential.

#### RAMP SYNTHESIS METHODS AND ASSUMPTIONS

This program evaluates either conventional stiffened sheet or honeycomb construction ramp panels. Figure 15 shows the structural model of a stiffened sheet construction ramp. The ramp is assumed to consist of a panel, which resists longitudinal loads, and transverse hinge beams at the forward and aft edges. Two hinge points are located on each hinge beam at a fraction,  $K_w$ , of the ramp width. Should an actuator be located on the ramp, an actuator beam is also present. This beam is assumed to be similar to the hinge beam, except that beam depth may be greater than the panel depth.

The basic assumption in the synthesis approach is that elements may be identified as shear members and axial members, and that these elements may be sized for shear and bending moment, respectively. Ramps are either pinned jointed at both ends or pinned at one end with rollers on the other. Ramps with both edges pin-jointed may have axial load introduced at the hinges. This axial load is assumed to be negligible compared to bending moment and, therefore, is not considered in the sizing calculations. However, axial load is considered in the equations for system static equilibrium.

Since structure sized by loads may represent less than minimum gage structure, tests on minimum weight are also performed. Final estimated weights for each of the analytically calculated elements are derived by applying indexing factors. These factors are considered to be calibration factors for design parameters and unique conditions that are not considered in the analysis. Index factors are determined by program calibration runs on existing hardware.

Basic geometry and design data are shown in Table 3. Predefined values, which may be revised by user input, are also presented in this table.

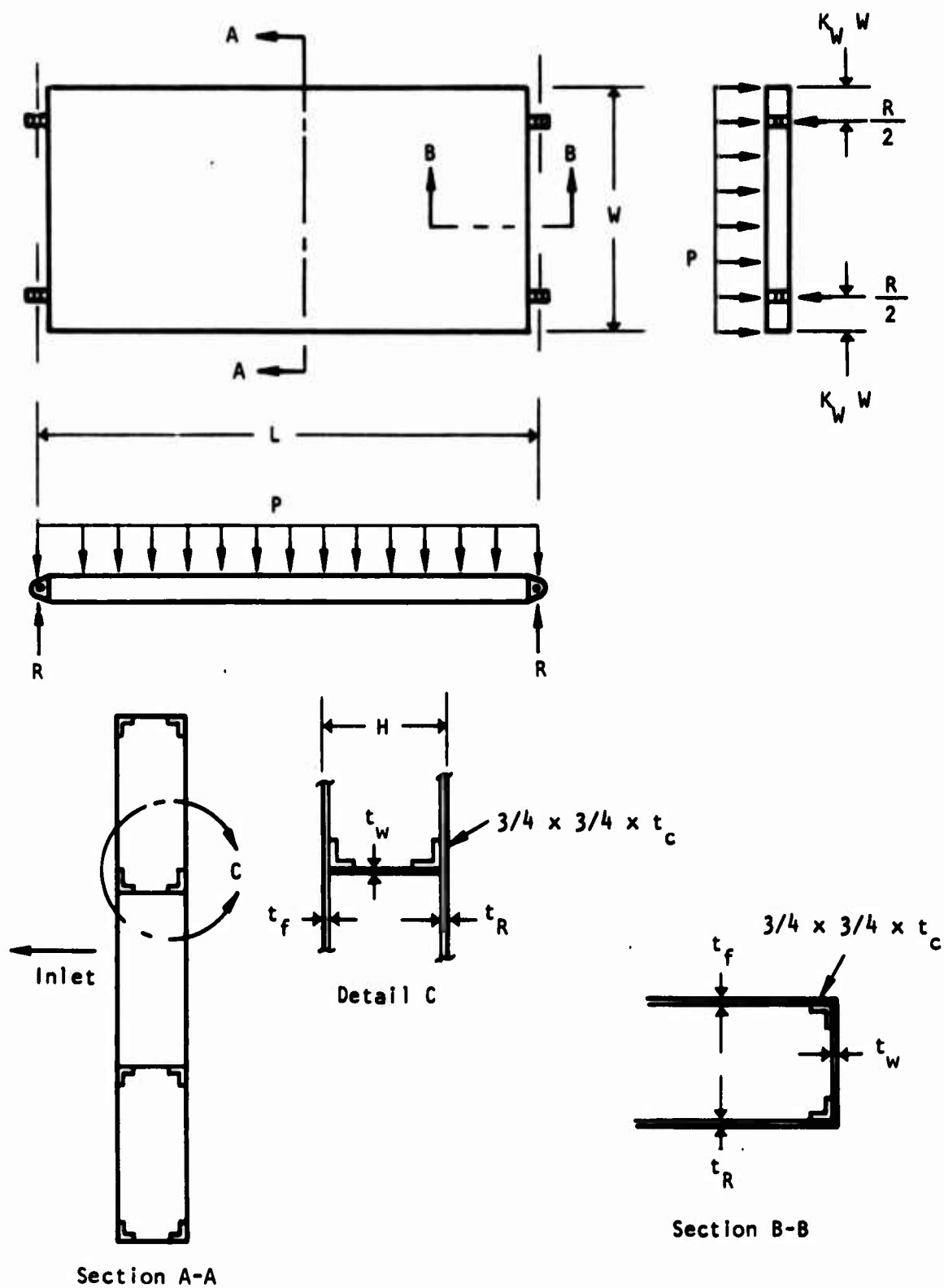


Figure 15. Ramp structural representation.

TABLE 3. BASIC RAMP GEOMETRY AND DESIGN DATA

FORTRAN Name	Engrg Symbol	Value	Description
DADI	$\rho_a$	0.1	Adhesive density per honeycomb panel facesheet, psf
DCORE	$\rho_c$	4.4	Honeycomb core density, lb/ft <sup>3</sup>
DENS	$\rho$		Ramp material density, lb/in. <sup>3</sup>
FCY	$F_{cy}$		Ramp material compression yield stress, psi
FSU	$F_{su}$		Ramp material ultimate shear strength, psi
PHS			Ultimate absolute hammershock pressure, psia
W1	$W, W_1$		Width of ramp 1, in.
W2	$W, W_2$		Width of ramp 2, in.
W3	$W, W_3$		Width of ramp 3, in.
W4	$W, W_4$		Width of ramp 4, in.
XCL	$K_{CL}$	0.9	Ratio of effective height between axial members to total panel depth (stiffened sheet construction only)
XCT	$K_{CT}$	0.9	Ratio of effective height between transverse beam caps to total beam depth (stiffened sheet construction only)
XFCY	$K_{FCY}$	0.5	Ratio of allowable compression stress to compression yield stress (stiffened sheet construction only)

TABLE 3. BASIC RAMP GEOMETRY AND DESIGN DATA (CONCL)

FORTTRAN Name	Engrg Symbol	Value	Description
XFSU	$K_{FSU}$	0.5	Ratio of allowable shear stress to ultimate shear strength (stiffened sheet construction only)
XL1	$L, L_1$		Length of ramp 1, in.
XL2	$L, L_2$		Length of ramp 2, in.
XL3	$L, L_3$		Length of ramp 3, in.
XL4	$L, L_4$		Length of ramp 4, in.
XW	$K_W$	0.25	Ratio of hinge position from panel edge to panel width ( $0.25 \leq K_W \leq 0.5$ )

### Panel Synthesis

For the arrangement and pressure loading (P) in Figure 15, the reactions and shear and bending moment diagrams are shown in the sketch.

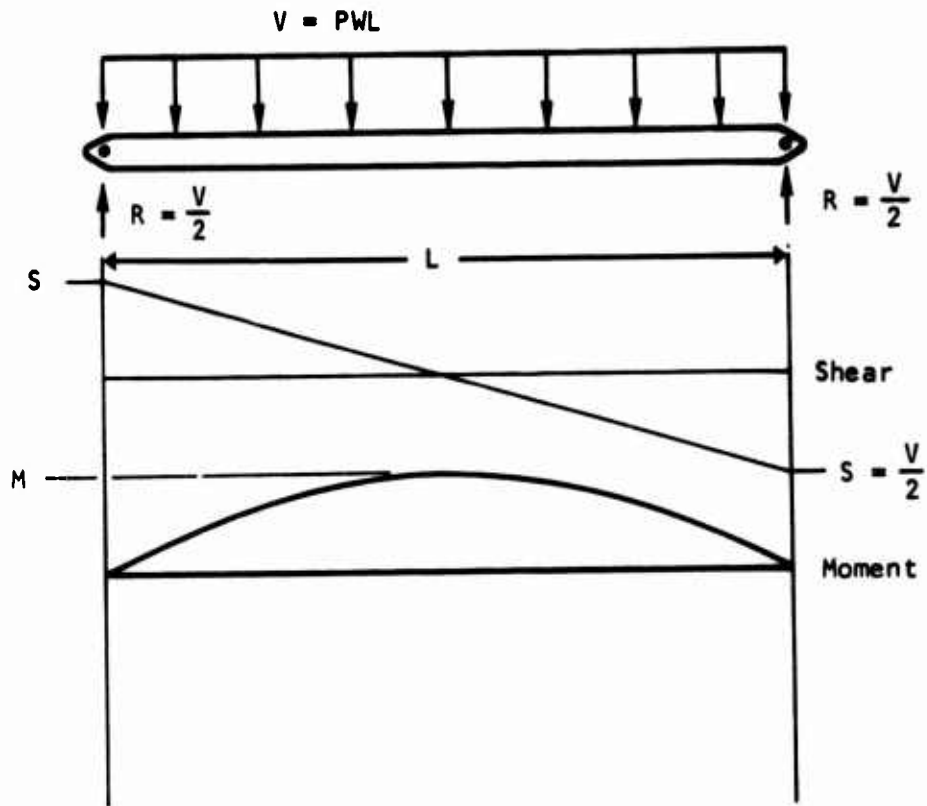
where

P = differential pressure, psi

Maximum shear, S, occurs at the hinge, and the maximum moment, M, occurs at midspan.

$$S = \frac{V}{2} \quad (79)$$

$$M = \frac{PL^2W}{8} = \frac{VL}{8} \quad (80)$$



#### Stiffened Sheet Construction

Bending moment is assumed to be reacted by the cover and longitudinal beam caps. Axial load,  $F$ , and required area,  $A$ , are calculated by equations 81 and 82.

$$F = \frac{M}{K_{CL} H} \quad (81)$$

$$A_L = \frac{F}{K_{FCY} F_{CY}} = \frac{M}{K_{CL} H K_{FCY} F_{CY}} \quad (82)$$

where

$H$  = panel depth, in.

Shear flow, reacted by longitudinal beam webs, and required web thickness are calculated by equations 83 and 84.

$$q = \frac{S}{K_{CL} H} \quad (83)$$

$$t = \frac{q}{K_{FSU} F_{SU}} = \frac{S}{K_{CL} H K_{FSU} F_{SU}} \quad (84)$$

Panel weight can then be calculated by equation 85 which combines axial load elements and shear members.

$$\begin{aligned} WT_L &= I_L \rho (2A_L L + tHL) \\ &= \frac{I_L \rho L}{K_{CL}} \left( \frac{2M}{H K_{FCY} F_{CY}} + \frac{S}{K_{FSU} F_{SU}} \right) \end{aligned} \quad (85)$$

where

$I_L$  = panel weight correlation factor

#### Honeycomb Panel Construction

For honeycomb panels, bending moment is reacted by the facesheets, and shear is reacted by the honeycomb core. Since all of the axial load is reacted by the facesheets, panel depth is assumed to be the effective couple arm. Furthermore, due to stabilization by the core, the allowable facesheet stress is assumed to be equal to the material compression yield stress. Equations 86 and 87 are used to calculate axial load and facesheet area.

$$F = \frac{M}{H} \quad (86)$$

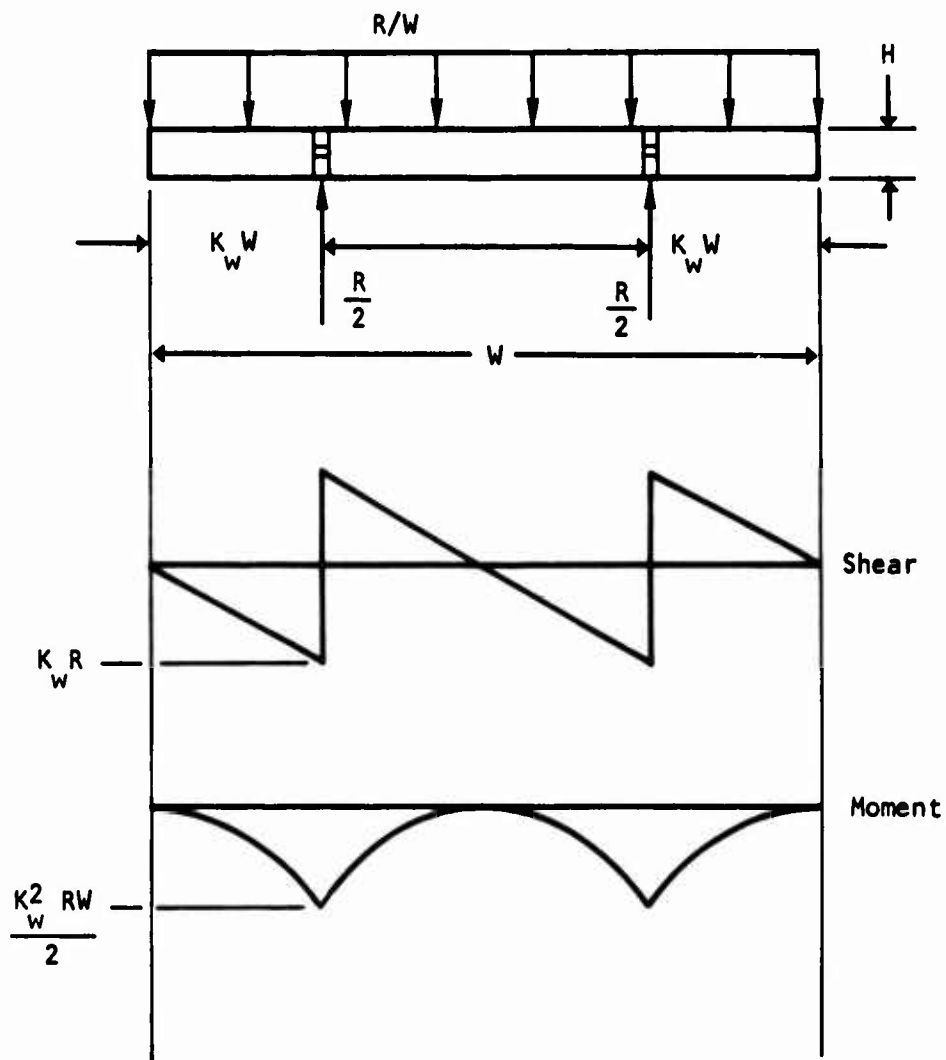
$$A = \frac{M}{H F_{CY}} \quad (87)$$

Panel weight is calculated by equation 88, which combines facesheet, core, and bonding material.

$$WT_L = I_L L \left( \frac{2\rho_M}{H F_{CY}} + \frac{\rho_{WH}}{1728} + \frac{2\rho_a}{144} \right) \quad (88)$$

## Hinge and Actuator Beam Synthesis

For the assumed arrangement (Figure 15), hinge or actuator loads are assumed to be distributed to the panel as a uniform shear flow. With this assumption, shear and bending moment diagrams can be constructed as shown in the sketch.



In the foregoing diagrams, the maximum shear and moment occur at the hinge point. This is true when the value of  $K_W$  is equal to or greater than 0.25.

## Stiffened Sheet Construction

Transverse beam cap area and web thickness can be calculated by using equations 89 and 90, which are obtained by substituting terms in equations 81 through 84.

$$A_T = \frac{M}{K_{CT} H K_{FCY} F_{CY}} = \frac{k_W^2 RW}{2 K_{CT} H K_{FCY} F_{CY}} \quad (89)$$

$$t_T = \frac{K_W R}{K_{CT} H K_{FSU} F_{SU}} \quad (90)$$

where

H = panel depth for hinge beams or actuator beam depth, in.

Weight of one hinge beam or actuator beam is calculated by equation 91.

$$\begin{aligned} WT_t &= I_T \rho (2A_T W + t_T HW) \\ &= \frac{I_T \rho K_W WR}{K_{CT}} \left( \frac{K_W W}{H K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \end{aligned} \quad (91)$$

where

$I_T$  = transverse beam weight correlation factor

## Honeycomb Construction

Transverse beams on honeycomb panels are assumed to be stabilized by the core. Weight is calculated by equation 92 which assumes fully effective cap and web material.

$$WT_T = I_T \rho K_W WR \left( \frac{K_W W}{H F_{CY}} + \frac{1}{F_{SU}} \right) \quad (92)$$

### Minimum Weight

Minimum practical structure is not considered in the preceding synthesis and weight formulations. To preclude ramp weights that are not practical, minimum structure weight is compared with structure weight based on loading, and the heavier weight is used. Minimum weight structure is calculated for the same size ramp with assumed practical minimum type construction and material gages.

Predefined fabrication minimums are shown in Table 4. Thickness and density values in this table may be revised by user input.

#### Panel, Stiffened Sheet Construction

Minimum-weight panel is assumed to consist of two cover panels and four longitudinal beams, as shown in Figure 12. Weight is calculated by equation 93.

$$WTML = I_M \rho L (W (t_f + t_r) + 4 (3t_c + Ht_w)) \quad (93)$$

where

$I_M$  = minimum-weight correlation factor

#### Panel, Honeycomb Construction

Minimum honeycomb panel weight is calculated by equation 94.

$$WTML = I_M WL \left( 2 \rho t_s + \frac{H \rho_c}{1728} + \frac{2 \rho_a}{144} \right) \quad (94)$$

#### Transverse Beams

Cross-section geometry of a minimum transverse hinge beam is identical to that of a longitudinal beam. Weight is calculated by equation 95.

$$WTMT = I_P W (3t_c + Ht_w) \quad (95)$$

TABLE 4. RAMP STRUCTURE MINIMUM GAGES AND DENSITIES

General Terms			Aluminum		Titanium		Steel	
FORTAN Name	Engrg Symbol	Description	FORTAN Name	Value	FORTAN Name	Value	FORTAN Name	Value
TC	$t_c$	Longitudinal stiffener or transverse beam cap thickness, in. ( $3/4 \times 3/4 \times t_c$ )	TCA	0.040	TCT	0.025	TCS	0.020
TW	$t_w$	Stiffener or beam web thickness, in.	TWA	0.020	TWT	0.013	TWS	0.010
TBARF	$t_f$	Panel front sheet thickness, in.	TBARFA	0.040	TBARFT	0.025	TBARFS	0.020
TBARA	$t_r$	Panel rear sheet thickness, in.	TBARRA	0.010	TBARRT	0.010	TBARRS	0.010
TS	$t_s$	Honeycomb panel facesheet thickness, in.	TSA	0.015	TST	0.010	TSS	0.010
DCORE	$\rho_c$	Honeycomb core density, lb/ft <sup>3</sup>	DCORE	4.4	DCORE	4.4	DCORE	4.4
DADH	$\rho_a$	Adhesive density per facesheet, lb/ft <sup>2</sup>	DADH	0.1	DADH	0.1	DADH	0.1

Minimum actuator beam weight, WTMA, is also calculated by equation 95. Actuator beam depth is substituted for panel depth, H, in the foregoing equation.

## TWO-RAMP SYSTEM

Figure 16 is a schematic diagram illustrating pressure forces, actuator location, and geometry assumptions for a two-ramp system. Basic geometry, pressure, material properties, and minimum gage data and symbols are presented in Tables 3 and 4. Additional detail input data are shown in Table 5. Predefined values, which may be revised by user input, are also presented in these tables.

Ramp 2 in a two-ramp system is always assumed to be stiffened sheet construction. Ramp 1 may be specified to be either honeycomb or stiffened sheet structure.

### Ramp Structure Geometry

Panel lengths and widths are user input data. Panel depths are defined as fractions of length and or width. Actuator beam depth is defined as a fraction of panel width. Depth of ramps 1 and 2 ( $H_1$ ,  $H_2$ ) are calculated as follows:

$$H_1 = \text{Maximum of } (XHT2 W, \text{ or } XH21 L_1) \quad (96)$$

$$H_2 = \text{Maximum of } (XHT2 W_2 \text{ or } XH22 L_2) \quad (97)$$

Actuator beam depth is calculated by equation 98.

$$H_{A2} = XHTA2 W_2 \quad (98)$$



TABLE 5. TWO-RAMP SYSTEM VARIABLES

FORTTRAN Name	Engrg Symbol	Value	Description
ALPHA2	$\alpha$	30.0	Angle between projected face of ramp 1 and ramp 2, deg
XHTA2		0.15	Actuator beam depth to panel width ratio for ramp 2
XHT2		0.1	Panel depth to width ratio for each ramp
XH21		0.1	Panel depth to length ratio for ramp 1
XH22		0.07	Panel depth to length ratio for ramp 2
XIL21	$I_L$	1.0	Ramp 1 panel weight correlation factor
XIL22	$I_L$	1.0	Ramp 2 panel weight correlation factor
XIM21	$I_M$	1.0	Ramp 1 minimum weight correlation factor
XIM22	$I_M$	1.0	Ramp 2 minimum weight correlation factor
XITAH2	$I_T$	1.0	Ramp 2 aft hinge beam weight correlation factor
XITA2	$I_T$	1.0	Ramp 2 actuator beam weight correlation factor
XITFH2	$I_T$	1.0	Ramp 2 forward hinge beam weight correlation factor
XIT21	$I_T$	1.0	Ramp 1 hinge beam weight correlation factor

TABLE 5. TWO-RAMP SYSTEM VARIABLES (CONCL)

FORTRAN Name	Engrg Symbol	Value	Description
XK21	$K_1$	0.2	Fraction of length of ramp 2 from forward edge to actuator location
XK22	$K_2$	0.8	Fraction of length of ramp 2 from aft edge to actuator location
XP21		0.5	Differential pressure on ramp 1, fraction of ultimate hammer shock pressure
XP22		0.4	Differential pressure on ramp 2, fraction of ultimate hammer shock pressure

### Resolution of Forces

Differential pressure on ramps 1 and 2 are calculated by equations 99 and 100.

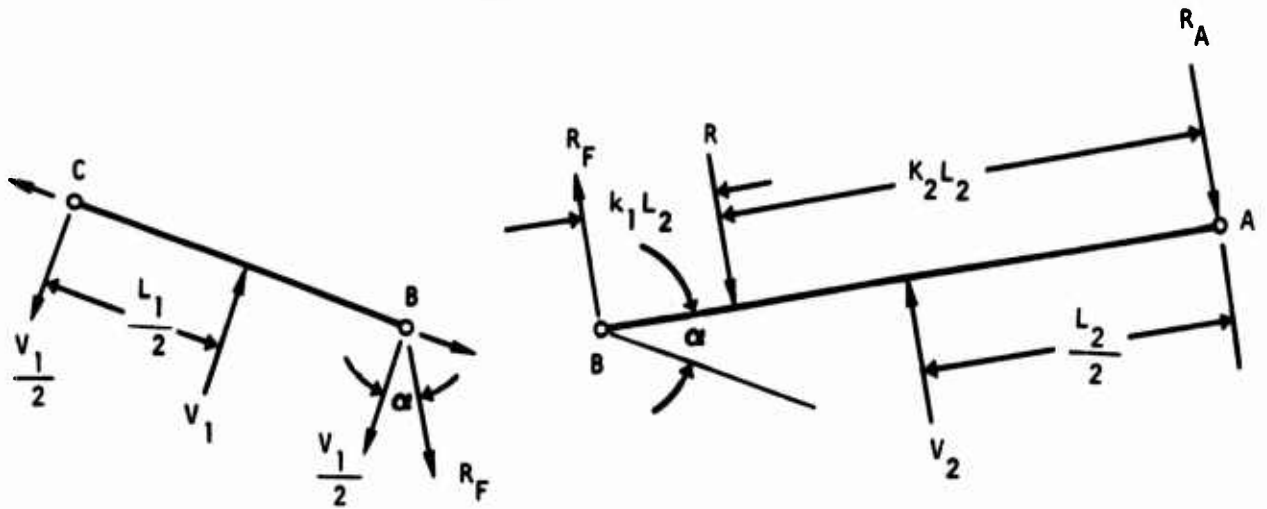
$$P_1 = PHS \text{ XP21} \quad (99)$$

$$P_2 = PHS \text{ XP22} \quad (100)$$

The total force on the panels due to differential pressure is the resultant of pressure times the corresponding panel area

$$V_1 = P_1 L_1 W_1 \quad (101)$$

$$V_2 = P_2 L_2 W_2 \quad (102)$$



For moment equilibrium of ramp 1, reactions normal to the panel surface at the hinges are equal to half the force,  $V_1$ , on the panel. At the hinge between ramps 1 and 2, the forces are equal and opposite. Therefore, reaction at the hinge is calculated by equation 103.

$$R_F = \frac{V_1}{2\cos \alpha} \quad (103)$$

Actuator reaction,  $R$ , is obtained by solving for moment equilibrium about A.

$$\sum M_A = 0 = R_F L_2 + \frac{V_2 L_2}{2} - R K_2 L_2 \quad (104)$$

and

$$R = \frac{R_F}{K_2} + \frac{V_2}{2K_2} \quad (105)$$

Reaction at A is calculated for force equilibrium.

$$\Sigma F = 0 = R_F + V_2 - R - R_A \quad (106)$$

and

$$R_A = R_F + V_2 - R \quad (107)$$

### Ramp 1 Weight

Ramp 1 loading is identical to that for the typical structural representation (Figure 15). Therefore, component weights are calculated by substitution of ramp 1 parameters in the previously derived equations, equations 79 through 88.

Maximum panel bending moment, M, is calculated by equation 108. Panel weight is calculated by equation 109 for stiffened sheet construction or equation 110 for honeycomb construction.

$$M = \frac{P_1 L_1^2 W_1}{8} = \frac{V_1 L_1}{8} \quad (108)$$

$$WT_L = \frac{I_L \rho V_1 L_1}{2K_{CL}} \left( \frac{L_1}{2H_1 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (109)$$

$$WT_L = I_L L_1 \left( \frac{\rho V_1 L_1}{4H_1 F_{CY}} + \frac{\rho W_1 H_1}{1728} + \frac{2\rho W_a}{144} \right) \quad (110)$$

Hinge beam weight (two hinges) is calculated by equation 111 if the panel is stiffened sheet construction or equation 112 on a honeycomb panel.

$$WT_T = \frac{I_T \rho K_W W_1 V_1}{K_{CT}} \left( \frac{K_W W_1}{H_1 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (111)$$

$$WT_T = I_T \rho K_W W_1 V_1 \left( \frac{K_W W_1}{H_1 F_{CY}} + \frac{1}{F_{SU}} \right) \quad (112)$$

### Ramp 2 Weight

Ramp 2 is always assumed to be stiffened sheet construction. Assuming that the maximum shear and moment on ramp 2 occurs at the actuator reaction point, equations 113 and 114 are used to calculate bending moment and shear.

$$M = K_1 L_2 \left( R_F + \frac{K_1 V_2}{2} \right) \quad (113)$$

$$S = R_F + K_1 V_2 \quad (114)$$

Panel weight is calculated by equation 115 which is obtained by substitution of terms in equation 85.

$$WT_L = \frac{I_L \rho L_2}{K_{CL}} \left( \frac{2M}{H_2 K_{FCY} F_{CY}} + \frac{S}{K_{FSU} F_{SU}} \right) \quad (115)$$

The hinge and actuator beam weights are calculated by equations 116 through 118. These equations are the result of substitution in equation 91.

$$WT_{TFH} = \frac{I_T \rho K_W W_2 R_F}{K_{CT}} \left( \frac{K_W W_2}{H_2 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SI}} \right) \quad (116)$$

$$WT_{TAH} = \frac{I_T \rho K_W W_2 R_A}{K_{CT}} \left( \frac{K_W W_2}{H_2 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (117)$$

$$WT_{TA} = \frac{I_T^P K_W W_2^R}{K_{CT}} \left( \frac{K_W W_2}{H_{A2} K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (118)$$

where

$WT_{TFH}$  = forward hinge beam weight, lb

$WT_{TAH}$  = aft hinge beam weight, lb

$WT_{TA}$  = actuator beam weight, lb

### THREE-RAMP SYSTEM

Figure 17 is a schematic diagram illustrating pressure forces, actuator locations, and geometry assumptions for a three-ramp system. Basic geometry, pressure, material properties, and minimum gage data and symbols are presented in Tables 3 and 4. Additional detail input data are shown in Table 6. Predefined values, which may be revised by user input, are also presented in these tables.

Ramp 3 in a three-ramp system is always assumed to be stiffened sheet construction. Ramps 1 and 2 may be specified to be either honeycomb or stiffened sheet structure.

#### Ramp Structure Geometry

Panel lengths and widths are user input data. Panel depths are defined as fractions of length and or width. Ramp 3 actuator beam depth is defined to be a fraction of panel width. Depth of ramps 1, 2, and 3 ( $H_1$ ,  $H_2$ ,  $H_3$ ) are calculated as follows:

$$H_1 = \text{Maximum of } (XHT3 W_1 \text{ or } XH31 L_1) \quad (119)$$

$$H_2 = \text{Maximum of } (XHT3 W_2 \text{ or } XH32 L_2) \quad (120)$$

$$H_3 = \text{Maximum of } (XHT3 W_3 \text{ or } XH33 L_3) \quad (121)$$



TABLE 6. THREE-RAMP SYSTEM VARIABLES

FORTTRAN Name	Engrg Symbol	Value	Description
ALPHA3	$\alpha$	30.0	Angle between projected face of ramp 2 and ramp 3, deg
XHTA3		0.15	Actuator beam depth to width ratio for ramp 3
XHT3		0.1	Panel depth to width ratio for each ramp
XH31		0.1	Panel depth to length ratio for ramp 1
XH32		0.1	Panel depth to length ratio for ramp 2
XH33		0.07	Panel depth to length ratio for ramp 3
XIL31	$I_L$	1.0	Ramp 1 panel weight correlation factor
XIL32	$I_L$	1.0	Ramp 2 panel weight correlation factor
XIL33	$I_L$	1.0	Ramp 3 panel weight correlation factor
XIM31	$I_M$	1.0	Ramp 1 minimum weight correlation factor
XIM32	$I_M$	1.0	Ramp 2 minimum weight correlation factor
XIM33	$I_M$	1.0	Ramp 3 minimum weight correlation factor
XITAH3	$I_T$	1.0	Ramp 3 aft hinge beam weight correlation factor

TABLE 6. THREE-RAMP SYSTEM VARIABLES (CONCL)

FORTRAN Name	Engrg Symbol	Value	Description
XITA3	$I_T$	1.0	Ramp 3 actuator beam weight correlation factor
XITFH3	$I_T$	1.0	Ramp 3 forward hinge weight correlation factor
XIT31	$I_T$	1.0	Ramp 1 transverse beam weight correlation factor
XIT32	$I_T$	1.0	Ramp 2 transverse beam weight correlation factor
XK31	$K_1$	0.9	Fraction of length of ramp 1 from forward edge to actuator location
XK32	$K_2$	0.2	Fraction of length of ramp 3 from forward edge to actuator location
XK33	$K_3$	0.8	Fraction of length of ramp 3 from aft edge to actuator location
XP31		0.2	Differential pressure on ramp 1, fraction of ultimateammershock pressure
XP32		0.5	Differential pressure on ramp 2, fraction of ultimateammershock pressure
XP33		0.4	Differential pressure on ramp 3, fraction of ultimateammershock pressure

Actuator beam depths on ramps 1 and 3 ( $H_{A1}$ ,  $H_{A3}$ ) are defined as follows:

$$H_{A1} = H_1 \quad (122)$$

$$H_{A3} = XHTA3 W_3 \quad (123)$$

### Resolution of Forces

Differential pressure and the resultant forces due to these pressures are calculated by equations 124 through 129. These resultants act at the panel centroids (.5L, .5W).

$$P_1 = PHS \text{ XP31} \quad (124)$$

$$P_2 = PHS \text{ XP32} \quad (125)$$

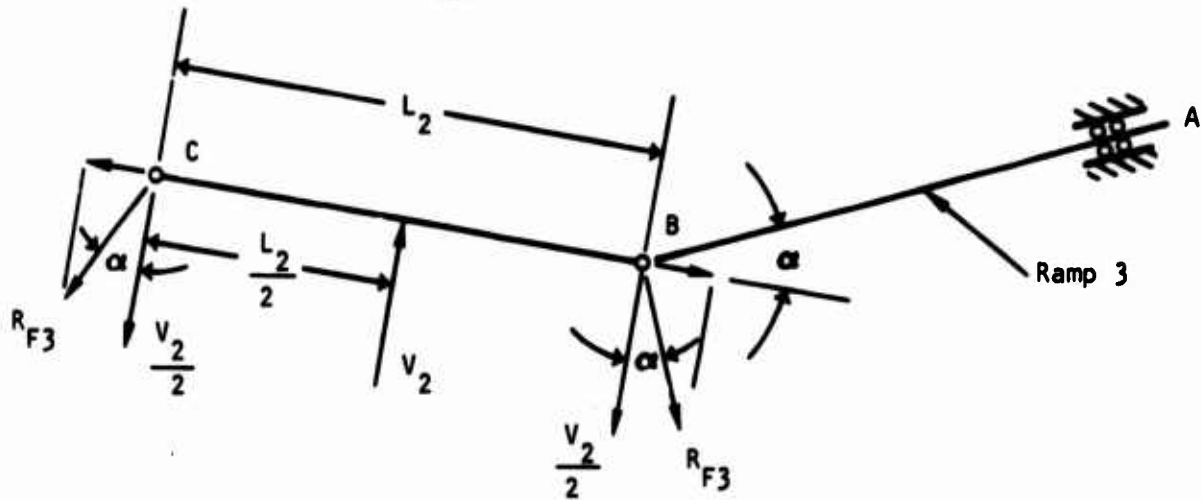
$$P_3 = PHS \text{ XP33} \quad (126)$$

$$V_1 = P_1 W_1 L_1 \quad (127)$$

$$V_2 = P_2 W_2 L_2 \quad (128)$$

$$V_3 = P_3 W_3 L_3 \quad (129)$$

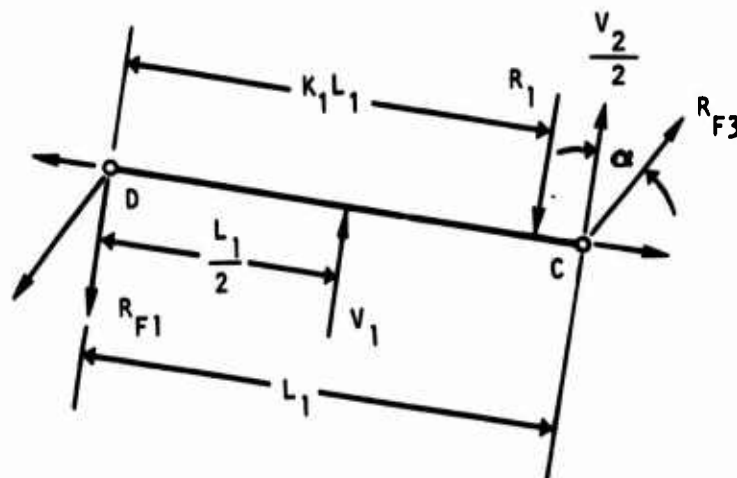
### Ramp 2, Freebody



Due to hinges at each end of ramp 2, reactions normal to the panel at B and C are equal to half the pressure force,  $V_2$ , on the panel. Due to the roller at A and actuator orientation perpendicular to ramp 3, all forces acting on ramp 3 are normal to the panel. Therefore, reaction at B is calculated by equation 130.

$$R_{F3} = \frac{V_2}{2 \cos \alpha} \quad (130)$$

### Ramp 1, Freebody



From the freebody of ramp 2, reaction at C is defined. Actuator reaction on ramp 1,  $R_1$ , is obtained by solving for moment equilibrium about D.

$$\Sigma M_D = 0 = \frac{V_1 L_1}{2} + \frac{V_2 L_1}{2} - R_1 K_1 L_1 \quad (131)$$

and

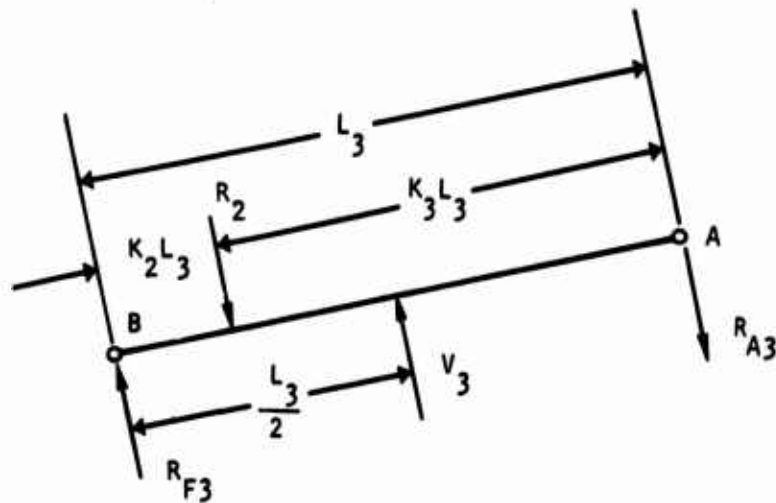
$$R_1 = \frac{V_1 + V_2}{2K_1} \quad (132)$$

Reaction normal to the panel at D,  $R_{F1}$ , is calculated by the equation of force equilibrium.

$$\Sigma F_V = 0 = V_1 + \frac{V_2}{2} - R_1 - R_{F1} \quad (133)$$

$$\begin{aligned} R_{F1} &= V_1 + \frac{V_2}{2} - R_1 \\ &= V_1 \left(1 - \frac{1}{2K_1}\right) + \frac{V_2}{2} \left(1 - \frac{1}{K_1}\right) \end{aligned} \quad (134)$$

Ramp 3, Freebody



Actuator reaction,  $R_2$ , is calculated by solving for moment equilibrium about A.

$$\Sigma M_A = 0 = R_{F3}L_3 + \frac{V_3L_3}{2} - R_2K_3L_3 \quad (135)$$

and

$$R_2 = \frac{R_{F3}}{K_3} + \frac{V_3}{2K_3} \quad (136)$$

Reaction at the aft hinge (roller) is calculated for force equilibrium.

$$\Sigma F_V = 0 = R_{F3} + V_3 - R_2 - R_{A3} \quad (137)$$

$$R_{A3} = R_{F3} + V_3 - R_2 \quad (138)$$

#### Ramp 1 Weight

The actuator on this ramp is assumed to be on or very near the aft hinge beam, such that the reaction at the forward hinge,  $R_{F1}$ , approaches the same value as on ramp 1 of a two-ramp system. Panel loads for this situation also approaches that for ramp 1 of a two-ramp system.

$$R_{F1} = V_1 \left( 1 - \frac{1}{2K_1} \right) + \frac{V_2}{2} \left( 1 - \frac{1}{K_1} \right) \rightarrow \frac{V_1}{2} \quad \left| \quad K_1 = 1 \right. \quad (139)$$

Panel weight can be calculated by using the same equations as are used for ramp 1 of a two-ramp system.

• Stiffened sheet construction:

$$W_{TL} = \frac{I_L \rho V_1 L_1}{2 K_{CL}} \left( \frac{L_1}{2H_1 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (140)$$

● Honeycomb construction:

$$WT_L = I_L L_1 \left( \frac{\rho V_1 L_1}{4H_1 F_{CY}} + \frac{\rho W_1 H_1}{1728} + \frac{2\rho W_1}{144} \right) \quad (141)$$

There are three transverse members - forward and aft hinge beams and an actuator beam. The actuator beam depth is assumed to be equal to the panel depth. Equation 142 is used to calculate the weight of these beams in stiffened sheet construction panels, and equation 143 is used for honeycomb construction.

● Stiffened sheet construction:

$$WT_T = \frac{I_T \rho K_W W_1}{K_{CT}} \left( R_{F1} + \frac{V_2}{2} + R_1 \right) \left( \frac{K_W W_1}{H_1 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (142)$$

● Honeycomb construction:

$$WT_T = I_T \rho K_W W_1 \left( R_{F1} + \frac{V_2}{2} + R_1 \right) \left( \frac{K_W W_1}{H_1 F_{CY}} + \frac{1}{F_{SU}} \right) \quad (143)$$

### Ramp 2 Weight

The loading on this panel is similar to that for ramp 1 of a two-ramp system. The following equations are used to calculate the component weights.

● Stiffened sheet construction:

$$WT_L = \frac{I_L \rho V_2 L_2}{2K_{CL}} \left( \frac{L_2}{2H_2 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (144)$$

$$WT_T = \frac{I_T \rho K_W W_2 V_2}{K_{CT}} \left( \frac{K_W W_2}{H_2 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (145)$$

• Honeycomb construction:

$$WT_L = I_L L_2 \left( \frac{\rho V_2 L_2}{4 H_2 F_{CY}} + \frac{\rho W_2 H_2}{1728} + \frac{2 \rho W_2}{144} \right) \quad (146)$$

$$WT_T = I_T \rho K_W W_2 V_2 \left( \frac{K_W W_2}{H_2 F_{CY}} + \frac{1}{F_{SU}} \right) \quad (147)$$

Ramp 3 Weight

Ramp 3 analysis is similar to that for ramp 2 of a two-ramp system. Equations 148 through 151 are used to calculate the component weights.

$$WT_L = \frac{I_L \rho L_3}{K_{CL}} \left( \frac{K_2 L_3 (2 R_{F3} + K_2 V_3)}{H_3 K_{FCY} F_{CY}} + \frac{R_{F3} + K_2 V_3}{K_{FSU} F_{SU}} \right) \quad (148)$$

$$WT_{TFH} = \frac{I_T \rho K_W W_3 R_{F3}}{K_{CT}} \left( \frac{K_W W_3}{H_3 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (149)$$

$$WT_{TAH} = \frac{I_T \rho K_W W_3 R_{A3}}{K_{CT}} \left( \frac{K_W W_3}{H_3 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (150)$$

$$WT_{TA} = \frac{I_T \rho K_W W_3 R_2}{K_{CT}} \left( \frac{K_W W_3}{H_{A3} K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (151)$$

FOUR-RAMP SYSTEM

Figure 18 is a schematic diagram illustrating pressure forces, actuator locations, and geometry assumptions for a four-ramp system. Basic geometry, pressure, material properties, and minimum gage data and symbols are presented in Tables 3 and 4. Additional detail input data are shown in Table 7. Pre-defined values, which may be revised by user input, are also presented in these tables.

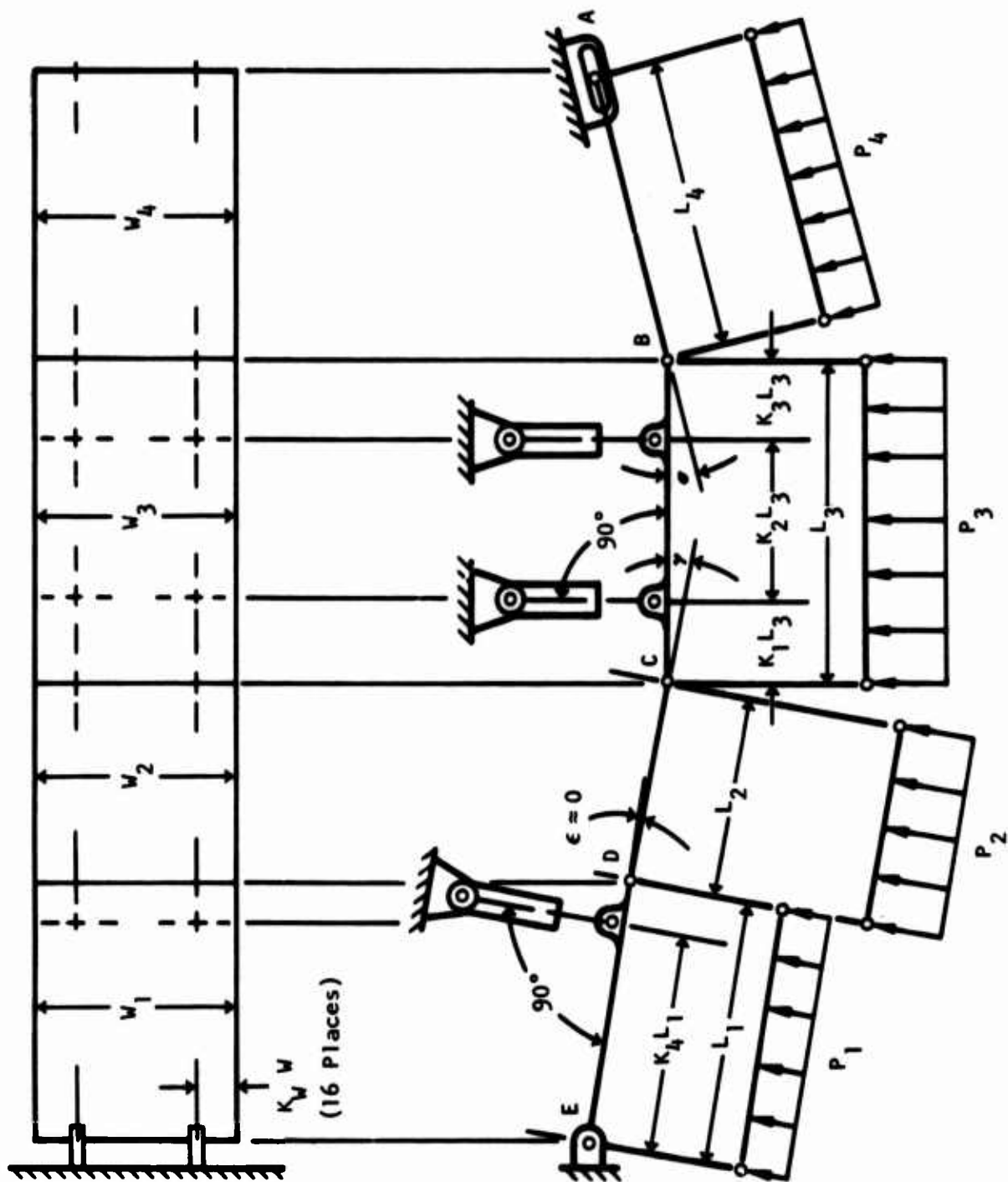


Figure 18. Typical four-ramp system.

TABLE 7. FOUR-RAMP SYSTEM VARIABLES

FORTTRAN Name	Engrg Symbol	Value	Description
GAMMA	$\gamma$	20.0	Angle between projected face of ramp 2 and ramp 3, deg
SIGMA	$\sigma$	10.0	Angle between projected face of ramp 3 and ramp 4, deg
XHTA4		0.125	Actuator beam depth to width ratio for ramp 3
XHT4		0.1	Panel depth to width ratio for each ramp
XH41		0.1	Panel depth to length ratio for ramp 1
XH42		0.1	Panel depth to length ratio for ramp 2
XH43		0.08	Panel depth to length ratio for ramp 3
XH44		0.1	Panel depth to length ratio for ramp 4
XIL41	$I_L$	1.0	Ramp 1 panel weight correlation factor
XIL42	$I_L$	1.0	Ramp 2 panel weight correlation factor
XIL43	$I_L$	1.0	Ramp 3 panel weight correlation factor
XIL44	$I_L$	1.0	Ramp 4 panel weight correlation factor
XIM41	$I_M$	1.0	Ramp 1 minimum weight correlation factor

TABLE 7. FOUR-RAMP SYSTEM VARIABLES (CONT)

FORTTRAN Name	Engrg Symbol	Value	Description
XIM42	$I_M$	1.0	Ramp 2 minimum weight correlation factor
XIM43	$I_M$	1.0	Ramp 3 minimum weight correlation factor
XIM44	$I_M$	1.0	Ramp 4 minimum weight correlation factor
XITAA4	$I_T$	1.0	Ramp 3 aft actuator beam weight correlation factor
XITAH4	$I_T$	1.0	Ramp 3 aft hinge beam weight correlation factor
XITFA4	$I_T$	1.0	Ramp 3 forward actuator beam weight correlation factor
XITFH4	$I_T$	1.0	Ramp 3 forward hinge beam weight correlation factor
XIT41	$I_T$	1.0	Ramp 1 transverse beam weight correlation factor
XIT42	$I_T$	1.0	Ramp 2 transverse beam weight correlation factor
XIT44	$I_T$	1.0	Ramp 4 transverse beam weight correlation factor
XK41	$K_1$	0.1	Fraction of length of ramp 3 from forward edge to forward actuator location
XK42	$K_2$	0.75	Fraction of length of ramp 3 distance between actuators
XK43	$K_3$	0.15	Fraction of length of ramp 3 from aft edge to aft actuator location

TABLE 7. FOUR-RAMP SYSTEM VARIABLES (CONCL)

FORTTRAN Name	Engrg Symbol	Value	Description
XK44	$K_4$	0.9	Fraction of length of ramp 1 from forward edge to actuator location
XP41		0.6	Differential pressure on ramp 1, fraction of ultimate hammershock pressure
XP42		1.0	Differential pressure on ramp 2, fraction of ultimate hammershock pressure
XP43		1.0	Differential pressure on ramp 3, fraction of ultimate hammershock pressure
XP44		0.4	Differential pressure on ramp 4, fraction of ultimate hammershock pressure

Ramp 3 in a four-ramp system is always assumed to be stiffened sheet construction. All of the other ramps may be specified to be either honeycomb or stiffened sheet structure.

#### Ramp Structure Geometry

Panel lengths and widths are user input data. Panel depths are defined as fractions of length and or width. Ramp 3 actuator beam depth is defined to be a fraction of panel width. Depth of ramps 1, 2, 3, and 4 ( $H_1$ ,  $H_2$ ,  $H_3$ , and  $H_4$ ) are calculated as follows:

$$H_1 = \text{Maximum of } (XHT4 W_1 \text{ or } XH41 L_1) \quad (152)$$

$$H_2 = \text{Maximum of } (XHT4 W_2 \text{ or } XH42 L_2) \quad (153)$$

$$H_3 = \text{Maximum of (XHT4 } W_3 \text{ or XH43 } L_3) \quad (154)$$

$$H_4 = \text{Maximum of (XHT4 } W_4 \text{ or XH44 } L_4) \quad (155)$$

Actuator beam depths on ramps 1 and 3 ( $H_{A1}$ ,  $H_{A3}$ ) are defined as follows:

$$H_{A1} = H_1 \quad (156)$$

$$H_{A3} = \text{XHTA4 } W_3 \quad (157)$$

#### Resolution of Forces

Differential pressure and the resultant forces due to these pressures are calculated by equations 158 through 165. These resultants act at the panel centroids (.5L, .5W).

$$P_1 = \text{PHS XP41} \quad (158)$$

$$P_2 = \text{PHS XP42} \quad (159)$$

$$P_3 = \text{PHS XP43} \quad (160)$$

$$P_4 = \text{PHS XP44} \quad (161)$$

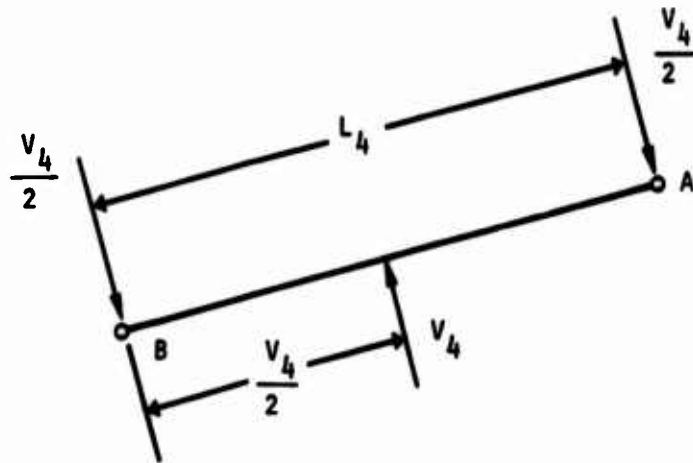
$$V_1 = P_1 L_1 W_1 \quad (162)$$

$$V_2 = P_2 L_2 W_2 \quad (163)$$

$$V_3 = P_3 L_3 W_3 \quad (164)$$

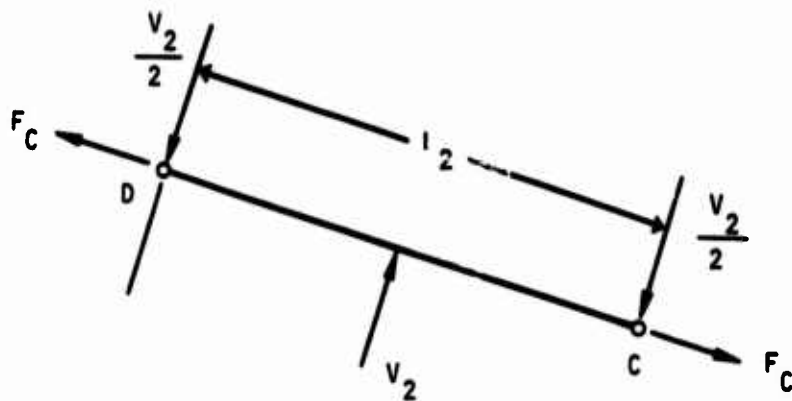
$$V_4 = P_4 L_4 W_4 \quad (165)$$

### Ramp 4 Freebody

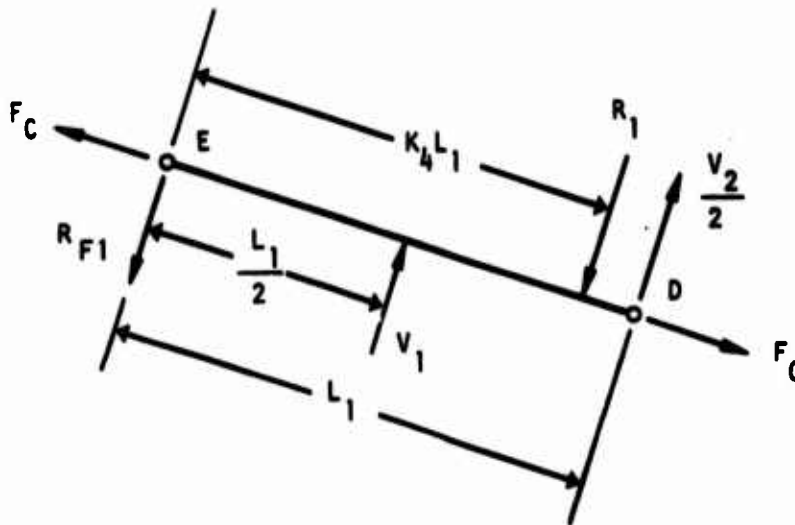


Due to the pin joint at B and the roller at A, reactions at the hinges are normal to the panel as shown in the freebody sketch.

### Ramp 2 Freebody



### Ramp 1 Freebody

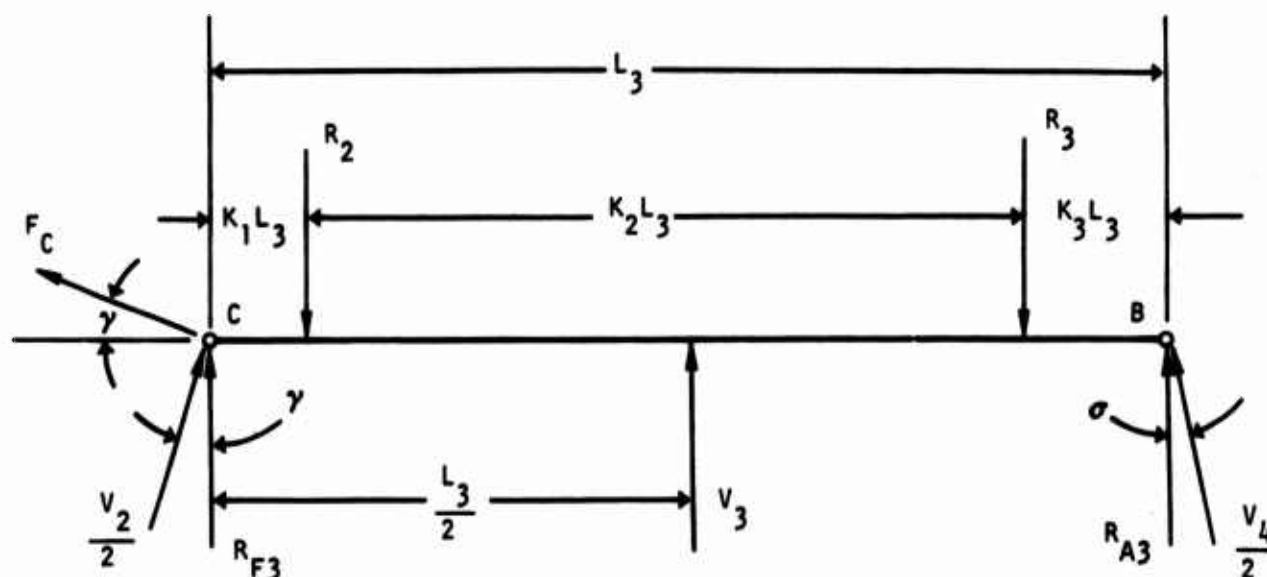


Similar to ramp 1 of a three-ramp system, the reactions normal to the panel are calculated by equations 166 and 167.

$$R_1 = \frac{V_1 + V_2}{2K_4} \quad (166)$$

$$R_{F1} = V_1 \left(1 - \frac{1}{2K_4}\right) + \frac{V_2}{2} \left(1 - \frac{1}{K_4}\right) \quad (167)$$

### Ramp 3 Freebody



From the freebody diagrams of ramps 2 and 4, reactions at the hinges are determined except for the force,  $F_C$ .  $F_C$  is determined for longitudinal balance of forces on ramp 3.

$$\Sigma F_L = 0 = \frac{V_4 \sin \sigma}{2} + F_C \cos \gamma - \frac{V_2 \sin \gamma}{2} \quad (168)$$

and

$$F_c = \frac{V_2 \tan \gamma}{2} - \frac{V_4 \sin \sigma}{2 \cos \gamma} \quad (169)$$

Reaction at B normal to the panel is given by equation 170.

$$R_{A3} = \frac{V_4 \cos \sigma}{2} \quad (170)$$

Reaction at C normal to the panel is obtained by equation 171.

$$\begin{aligned} R_{F3} &= F_c \sin \gamma + \frac{V_2 \cos \gamma}{2} \\ &= (V_2 \sin \gamma - V_4 \sin \sigma) \frac{\tan \gamma}{2} + \frac{V_2 \cos \gamma}{2} \end{aligned} \quad (171)$$

Actuator reactions,  $R_2$  and  $R_3$ , are obtained by solving for moment equilibrium.

$$\begin{aligned} \Sigma M_{R3} &= 0 = R_{F3} (K_1 + K_2) L_3 + V_3 \left( \frac{1}{2} - K_3 \right) L_3 - \\ &R_{A3} K_3 L_3 - R_2 K_2 L_3 \end{aligned} \quad (172)$$

and

$$R_2 = \frac{R_{F3} (K_1 + K_2) + V_3 \left( \frac{1}{2} - K_3 \right) - R_{A3} K_3}{K_2} \quad (173)$$

$$\Sigma M_{R2} = 0 = R_{F3} L_1 L_3 - V_3 \left( \frac{1}{2} - K_1 \right) L_3 - R_{A3} (K_2 + K_3) \quad (174)$$

$$L_3 + R_3 K_2 L_3$$

$$R_3 = \frac{V_3 \left( \frac{1}{2} - K_1 \right) + R_{A3} (K_2 + K_3) - R_{F3} K_1}{K_2} \quad (175)$$

#### Ramp 1 Weight

This ramp is similar to ramp 1 of a three-ramp system.

● Stiffened sheet construction:

$$W_{TL} = \frac{I_L \rho V_1 L_1}{2 K_{CL}} \left( \frac{L_1}{2H_1 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (176)$$

$$W_{TT} = \frac{I_T \rho K_W W_1}{K_{CT}} \left( R_{F1} + \frac{V_2}{2} + R_1 \right) \left( \frac{K_W W_1}{H_1 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (177)$$

● Honeycomb construction:

$$W_{TL} = I_L L_1 \left( \frac{\rho V_1 L_1}{4H_1 F_{CY}} + \frac{\rho_c W_1 H_1}{1728} + \frac{2\rho_a W_1}{144} \right) \quad (178)$$

$$W_{TT} = I_T \rho K_W W_1 \left( R_{F1} + \frac{V_2}{2} + R_1 \right) \left( \frac{K_W W_1}{H_1 F_{CY}} + \frac{1}{F_{SU}} \right) \quad (179)$$

### Ramp 2 Weight

This ramp is similar to ramp 2 of a three-ramp system.

● Stiffened shut construction:

$$WT_L = \frac{I_L \rho V_2 L_2}{2 K_{CL}} \left( \frac{L_2}{2H_2 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (180)$$

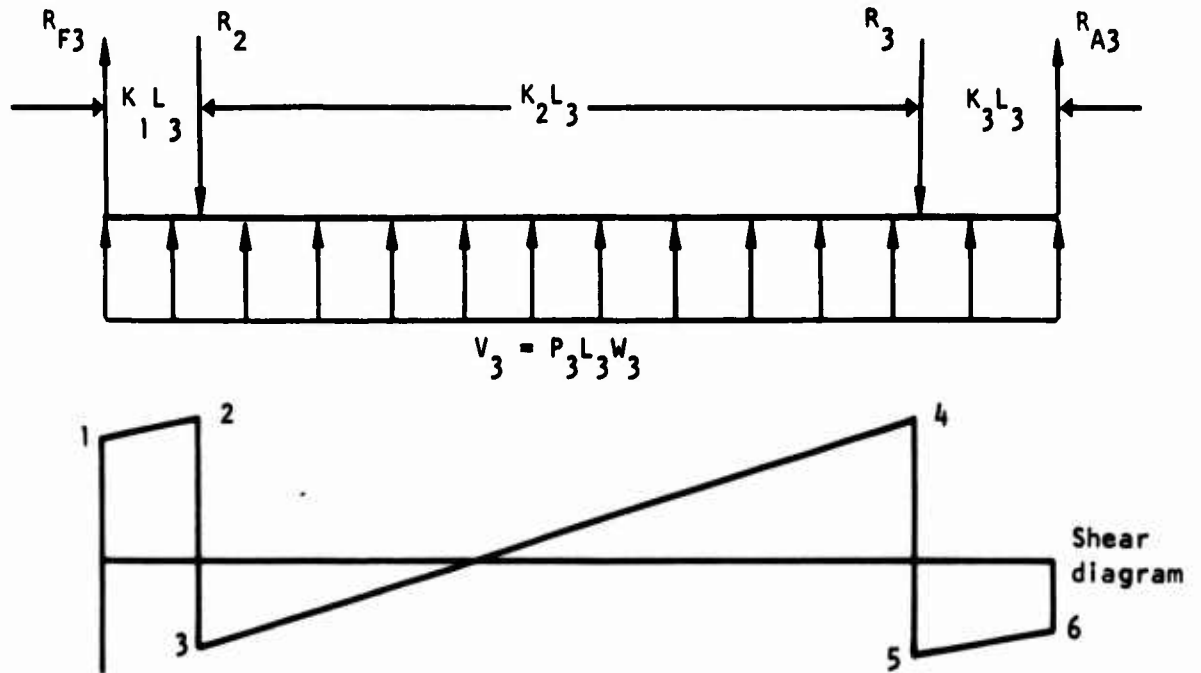
$$WT_T = \frac{I_T \rho K_W W_2 V_2}{K_{CT}} \left( \frac{K_W W_2}{H_2 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (181)$$

● Honeycomb construction:

$$WT_L = I_L L_2 \left( \frac{\rho V_2 L_2}{4H_2 F_{CY}} + \frac{\rho W_2 H_2}{1728} + \frac{2 \rho_a W_2}{144} \right) \quad (182)$$

$$WT_T = I_T \rho K_W W_2 V_2 \left( \frac{K_W W_2}{H_2 F_{CY}} + \frac{1}{F_{SU}} \right) \quad (183)$$

### Ramp 3 Weight



For weight estimating purposes, the maximum moment is assumed to be the maximum of the bending moment at the actuators and at the panel midspan.

$$M_{R2} = K_1 L_3 \left( R_{F3} + \frac{V_3 K_1}{2} \right) \quad (184)$$

$$M_{R3} = K_3 L_3 \left( R_{A3} + \frac{V_3 K_3}{2} \right) \quad (185)$$

$$M_{L2} = \frac{L_3}{2} \left( R_{F3} - R_2 (1 - 2K_1) + \frac{V_3}{4} \right) \quad (186)$$

$$M = \text{Absolute maximum of } (M_{R2}, M_{R3}, M_{L2}) \quad (187)$$

Design shear is obtained by selecting the absolute maximum shear of the values at points 1 through 6.

$$S_1 = R_{F3} \quad (188)$$

$$S_2 = R_{F3} + K_1 V_3 \quad (189)$$

$$S_3 = S_2 - R_2 \quad (190)$$

$$S_6 = R_{A3} \quad (191)$$

$$S_5 = R_{A3} + K_3 V_3 \quad (192)$$

$$S_4 = S_5 - R_3 \quad (193)$$

$$S = \text{Absolute maximum of } (S_1, S_2, S_3, S_4, S_5, S_6) \quad (194)$$

Design shear and bending moment are substituted into equation 85 to calculate panel weight as shown in equation 195.

$$WT_L = \frac{I_L L_3}{K_{CL}} \left( \frac{2M}{H_3 K_{FCY} F_{CY}} + \frac{S}{K_{FSU} F_{SU}} \right) \quad (195)$$

Hinge and actuator beam weights are calculated by equations 196 through 199.

$$WT_{TFH} = \frac{I_T \rho K_W R_{F3}}{K_{CT}} \left( \frac{K_W W_3}{H_3 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (196)$$

$$W_{T_{TAH}} = \frac{I_T \rho K_W R_{A3}}{K_{CT}} \left( \frac{K_W W_3}{H_3 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (197)$$

$$W_{T_{TFA}} = \frac{I_T \rho K_W R_2}{K_{CT}} \left( \frac{K_W W_3}{H_{A3} K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (198)$$

$$W_{T_{TAA}} = \frac{I_T \rho K_W R_3}{K_{CT}} \left( \frac{K_W W_3}{H_{A3} K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (199)$$

#### Ramp 4 Weight

This ramp is similar to ramp 2.

● Stiffened sheet construction:

$$W_{T_L} = \frac{I_L \rho V_4 L_4}{2 K_{CL}} \left( \frac{L_4}{2H_4 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (200)$$

$$W_{T_T} = \frac{I_T \rho K_W V_4}{K_{CT}} \left( \frac{K_W W_4}{H_4 K_{FCY} F_{CY}} + \frac{1}{K_{FSU} F_{SU}} \right) \quad (201)$$

● Honeycomb construction:

$$W_{T_L} = I_L L_4 \left( \frac{\rho V_4 L_4}{4H_4 F_{CY}} + \frac{\rho W_4 H_4}{1728} + \frac{2 \rho W_4}{144} \right) \quad (202)$$

$$W_{T_T} = I_T \rho K_W V_4 \left( \frac{K_W W_4}{H_4 F_{CY}} + \frac{1}{F_{SU}} \right) \quad (203)$$

### THREE-DIMENSIONAL AXIAL FLOW SYSTEMS (SPIKES)

Several types of spike arrangements are generally used in supersonic aircraft which are functions of inlet performance and operating environment. These include fixed spikes with no area control, translating spikes, and fully collapsing spikes for full area control. In the preliminary design phase of vehicle synthesis, geometry for three-dimensional inlet spike systems is not readily available. The estimating equations derived in Reference 6 account for this fact and, therefore, are based on inlet capture area which would be available in phase zero of configuration synthesis. The equations are the result of correlation with available inlet component weight with the significant design parameters.

Subroutine SPIKE uses equations 204 through 206 from Reference 6 to calculate weight estimates for the different types of three-dimensional spikes. Spike center of gravity is assumed to be at the inlet throat.

- Fixed spike weight, WHFS

$$WHFS = 12.53 (N_i) (A_i) \quad (204)$$

- Translating spike weight, WFTS

$$WFTS = 15.65 (N_i) (A_i) \quad (205)$$

- Translating and expanding spike weight, WTES

$$WTES = 5.18 (N_i) (A_i) \quad (206)$$

where

$N_i$  = number of inlets

$A_i$  = capture area per inlet,  $\text{ft}^2$

## NACELLE SHELL STRUCTURE

Nacelle weight estimating procedure consists of the evaluation of structural minimums, local panel flutter, and duct-nacelle compatibility. Loads are not evaluated in the current estimating method. This approach has been taken since nacelle shells are normally designed by other considerations. Engines, which produce the greatest impact on loads, are generally supported directly by pylon structure.

Nacelle synthesis and weight estimation calculations are performed in subroutine NACELE. This subroutine calls NCLGEO to calculate contour and segment geometry data.

## NACELLE GEOMETRY

Nacelle cross-sectional geometry is defined at as many as 10 longitudinal stations, starting at the inlet lip, station zero, and ending at the last full section of the nacelle. One-dimensional leading edges are defined as follows:

1. Horizontal leading edge - input zero for perimeter and actual width of leading edge
2. Wedge leading edges as would occur on nacelles with two inlet ducts with vertical leading edges - input zero for perimeter and depth at leading edge

Detail description of continuous section geometry and contour calculations is identical to that used to define duct geometry. Surface area for one-dimensional leading edge segments are calculated by equation 207 for horizontal leading edges and by equation 208 for wedge leading edges.

$$SFN_1 = \frac{DLXN_1}{2} (W_1 + BUN_2 + 2 BSN_2) \quad (207)$$

$$SFN_1 = \frac{DLXN_1}{2} (BUN_2 + BLN_2) \quad (208)$$

where

$SFN_1$  = nacelle leading edge segment surface area

$DLXN_1$  = leading edge segment length

$W_1$  = width of nacelle lip at station 1

$BUN_2$  = peripheral length of nacelle upper sector at station 2

$BSN_2$  = peripheral length of nacelle side sector at station 2

$BLN_2$  = peripheral length of nacelle lower sector at station 2

Curvature of the panels, although not pertinent in the current estimating procedure, are also calculated. The radius of curvature for circular nacelle sections are implicit. However, in the case of noncircular shapes, there is no true radius of curvature. Therefore, a nominal (weighted average) radius of curvature is defined in the following manner:

$$RCSN^2 = [RCSN - RON (1 - \cos 45^\circ)]^2 + (RON \sin 45^\circ + DON)^2 \quad (209)$$

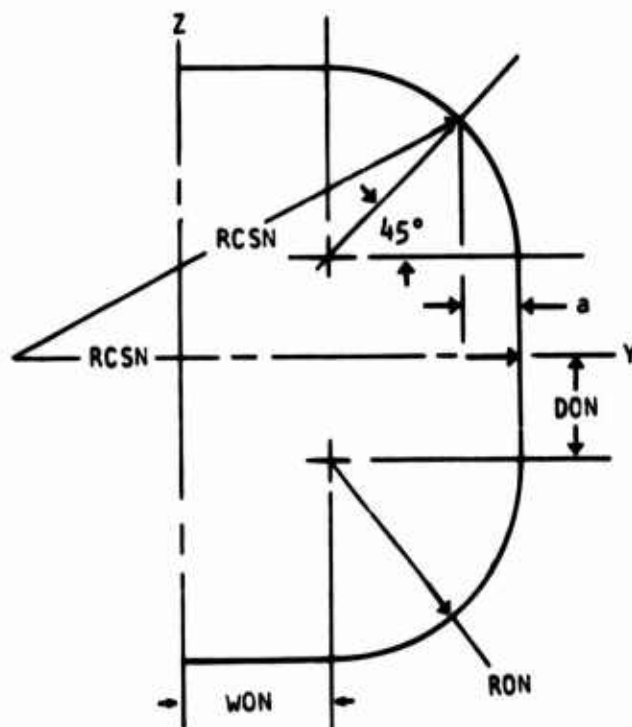
let

$$a = RON (1 - \cos 45^\circ) \quad (210)$$

$$b = RON \sin 45^\circ + DON \quad (211)$$

then

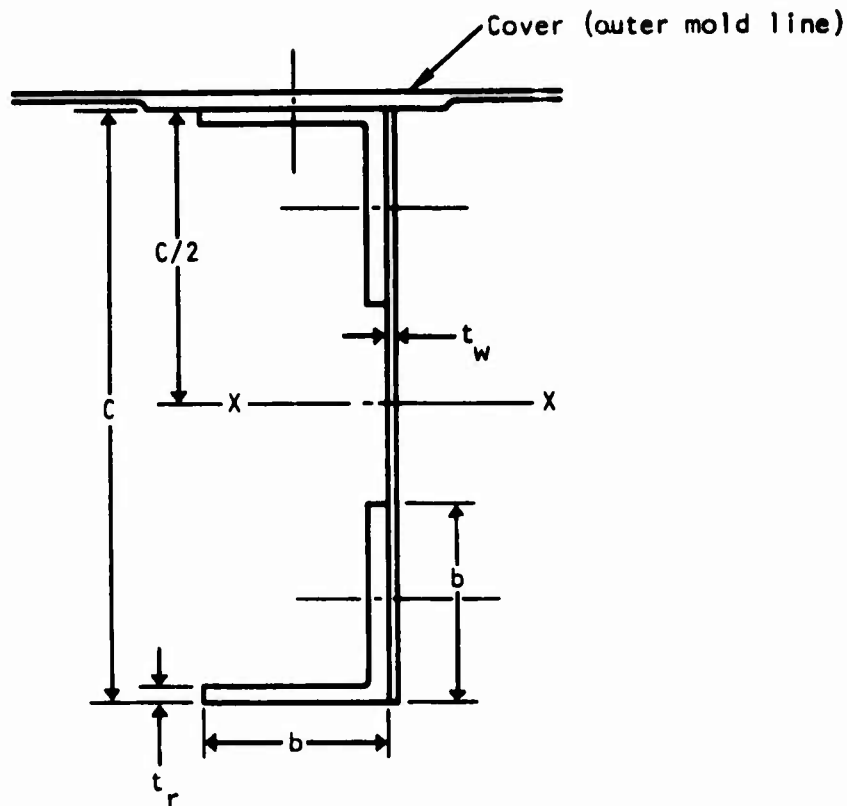
$$RCS = \frac{a^2 + b^2}{2a} \quad (212)$$



The nominal radius of curvature for the upper (RCUN) and lower (RCLN) sectors are calculated in the same manner. If the corner radius is less than 2 inches, the nominal radius of curvature is assumed to be infinite. A value of zero for curvature is used to designate the flat panel.

#### NACELLE SYNTHESIS

The nacelle is assumed to consist of an inlet section and an engine compartment section. This distinction is made to evaluate structural arrangement differences in the two sections. In the inlet section, frame weight and spacing are determined for duct design requirements. These data are developed by the duct estimating routines. Frame weight and spacing at nacelle cuts are obtained by interpolating between bounding duct cuts. Should two inlet ducts exist at a nacelle cut, the corresponding nacelle frame is assumed to be equivalent to two duct frames. Frame spacing in the engine compartment section is defined by input nacelle data. These frames are assumed to be constructed as shown in the following sketch. Frame weight is calculated from the user input parameters, frame depth (c), cap flange width (b), cap thickness ( $t_r$ ) and web thickness ( $t_w$ ).



Nacelle cover thicknesses at nacelle cuts are established by minimum gage and, for supersonic aircraft, by local panel flutter requirements, if critical. The appropriate frame spacing and side sector panel width (BSN) are used to determine thickness required to prevent local panel flutter at each nacelle cut.

#### Local Panel Flutter

Critical panel flutter requirements are derived by the program through a process of checking mach-altitude points for each of nine points on the limit speed envelope. The user has the option of inputting his own estimates of critical panel flutter parameters. These user inputs are checked against program-derived values to insure that all reasonably probable panel flutter conditions are adequately surveyed. The foregoing process does not evaluate subsonic flight conditions.

The approach used to insure the prevention of local panel flutter is based on methods described in Reference 7. This approach consists of the determination of the mach number parameter and the baseline design parameter. The baseline panel thickness obtained by this approach can then be revised by correction factors. These correction factors are independently derived to account for in-plane loaded panels, pressure differentials, curvature, and other parameters that influence flutter design.

The two significant parameters (in-plane stress and curvature) are not evaluated in SWEEP. The effect due to neglecting panel loading could introduce optimistic panel sizing, while the omission of curvature effects introduces conservatism in the analysis.

The mach number effects are derived by a curve-fit approximation of Figure 19<sup>(7)</sup>. The curve-fit equations are as follows:

- For mach 1.0 to 1.4:

$$F(M) = 0.4851674 + 1.66456 (M-1)^3 \quad (213)$$

- For mach 1.4 to 2.0:

$$F(M) = 0.488412 - 0.4037203 \cos \left( \frac{M - 1.4}{0.6} \pi \right) + 0.4849271 \sqrt{M^2 - 1} \quad (214)$$

- For mach > 2.0:

$$F(M) = \beta = \sqrt{M^2 - 1} \quad (215)$$

The baseline panel design curve <sup>(7)</sup> is shown in Figure 20. The curve used in SWEEP (subroutine NACELE) deviates from the proposed baseline curve for values of L/W less than 2. This difference, although less than the curve presented in NACA TN D-451 which reference 7 states as "excessive over design for some applications," reflects the current design practice.

The curve-fit approximation for this parameter is as follows:

$$\left( \frac{F(M)E}{q} \right)^{1/3} t/L = \phi_B = 0.5551841 - 0.1686944 (L/W) + 0.2169992 (L/W)^2 - 0.0007636935 (L/W)^3 \quad (216)$$

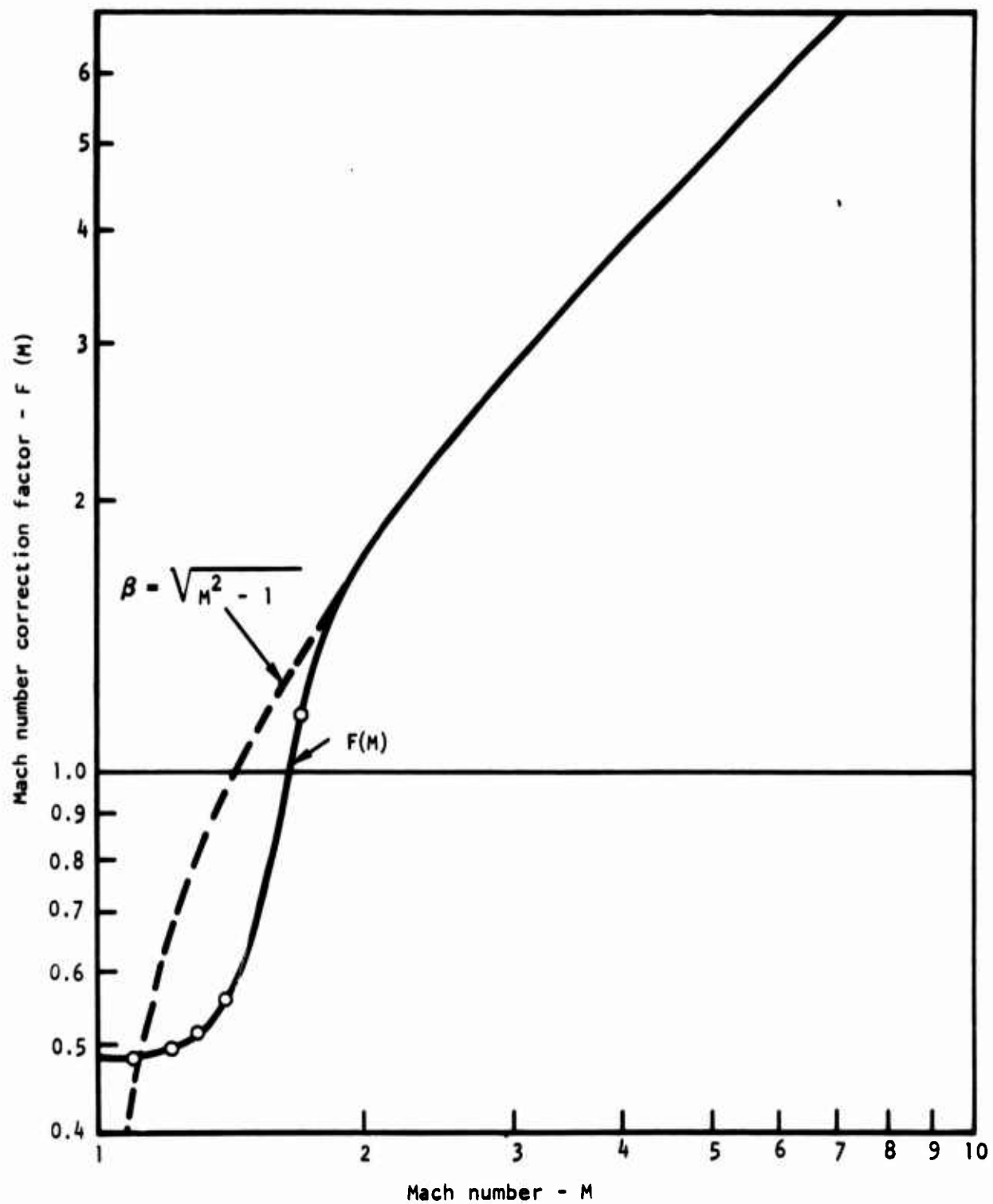


Figure 19. Panel flutter mach number correction factor.

$$\phi_B = \left[ \frac{F(M)E}{q} \right]^{\frac{1}{3}} t/L$$

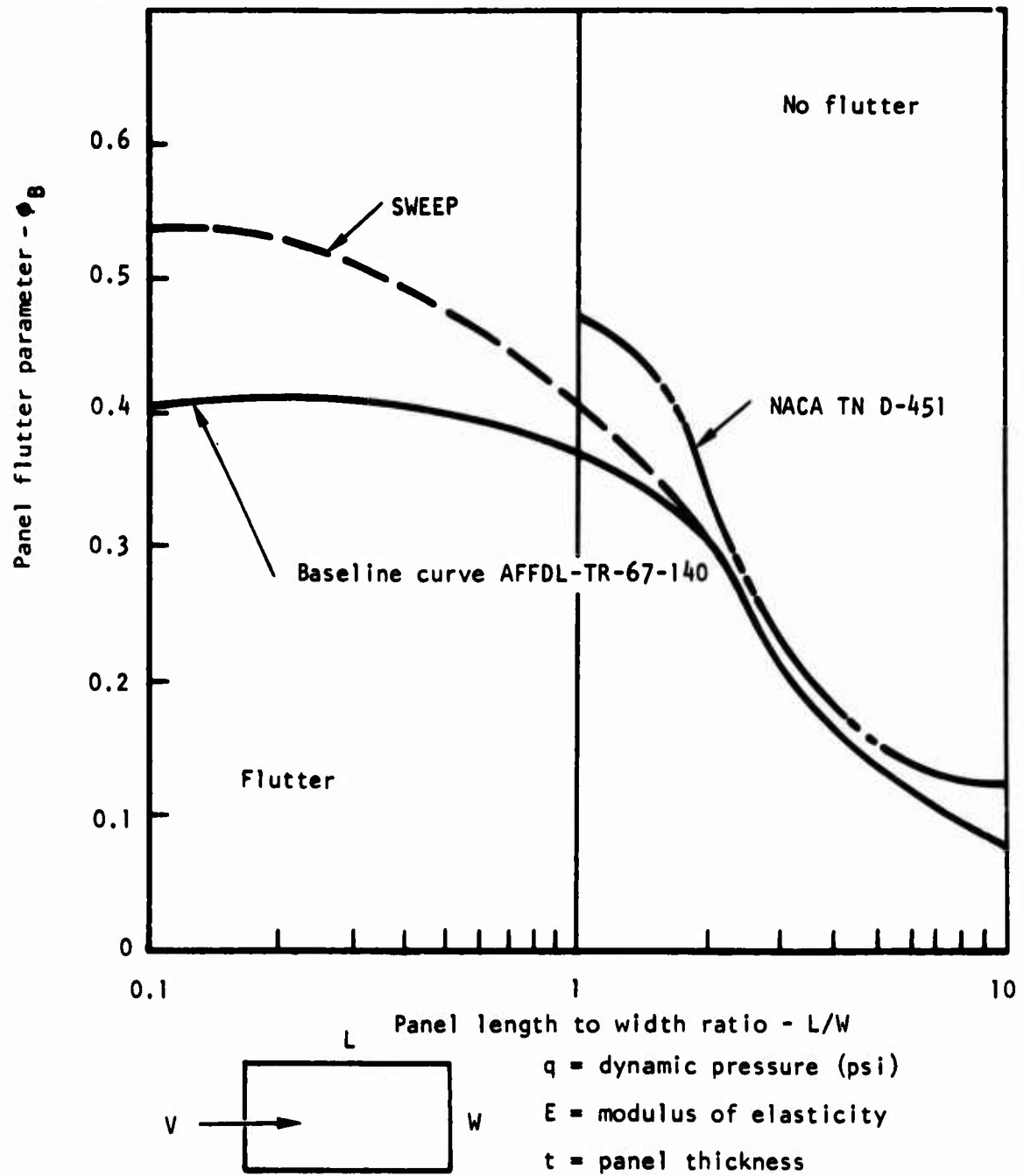


Figure 20. Panel flutter parameter versus aspect ratio.

For values of L/W greater than 10, this curve-fit approach is not valid. The value 10 is substituted for L/W should this condition occur. Although this assumption seems questionable, panels with aspect ratios greater than 10 rarely exist on nacelle structures.

The baseline thickness is then determined

$$t_b = \frac{\phi_B L}{\left[ \frac{F(M)E}{q} \right]^{1/3}} \quad (217)$$

The critical panel flutter speed is determined by investigating the vehicle flight envelope in terms of mach number and altitude. The flutter design point occurs when  $q/F(M) E$  is maximum.

#### Nacelle Shell Weight

Nacelle component weights are calculated for each nacelle segment. Should the first nacelle segment geometry define a one-dimensional leading edge structure, weight for that segment is not calculated to avoid duplication since the weight for that segment is calculated as part of the inlet duct structure.

Cover weight calculations are based on linear thickness taper between the forward and aft boundaries of segments. Cover panels which are replaced by engine removal doors are deleted in these weight calculations. Frame weight within segments are based on weight per linear inch at the bounding cuts.

Load redistribution structure weight is based on nacelle profile area. This calculation is performed for multiple engine nacelle arrangements where engine loads are reacted by nacelle structure which then transfers the loads to pylons. The weight is calculated at 1 pound per square foot of profile area.

Weight correlation factors are applied to the resultant weights for each of the shell components. Center-of-gravity calculations assume longitudinal segment weight centroids to be midway between bounding cuts.

## MISCELLANEOUS STRUCTURE WEIGHT

Miscellaneous air induction system, nacelle, and engine section structure, should they exist, are calculated in subroutines MISCOM and PYLONS. Table 8 is a summary of these components.

TABLE 8. MISCELLANEOUS STRUCTURE COMPONENT WEIGHTS

FORTTRAN Symbol	Description	Engine Instl Type	Calculation Routine
WTEM	Engine mount weight, lb	All	MISCOM
WTAI	Auxiliary inlet doors weight, lb	All	MISCOM
WTBP	Duct bypass doors weight, lb	All	MISCOM
WTED	Engine removal doors weight, lb	Nacelle	MISCOM
WTMD	Miscellaneous doors weight, lb	Nacelle	MISCOM
WTFW	Firewall weight, lb	Nacelle	MISCOM
WTEF	Exterior finish weight, lb	Nacelle	MISCOM
WTSD	Engine compartment shroud weight, lb	Nacelle	MISCOM
WTPI	Inboard pylons weight, lb	Nacelle	PYLONS
WTPO	Outboard pylons weight, lb	Nacelle	PYLONS
WFTI	Inboard fittings weight, lb	Nacelle	PYLONS
WFTO	Outboard fittings weight, lb	Nacelle	PYLONS

## ENGINE MOUNTS

Engine mounts and fittings weight is calculated by equation 218. The center of gravity is assumed to be at the engine CG.

$$W_{EM} = 0.015 W_E \quad (218)$$

where

$W_E$  = engine weight, lb

## AUXILIARY INLET AND DUCT BYPASS DOORS

The determination of duct bypass provisions or auxiliary inlet requirements are not within the scope of this program. However, should data be available for these items in the form of total panel size, the weights are calculated by equations 219 and 220. Center of gravity for the auxiliary inlet is assumed to be located one-third of the inlet length aft of the leading edge. Center of gravity for the duct bypass doors is assumed to be located two-thirds of the inlet length aft of the leading edge.

$$W_{TAI} = 12.0 S_{AI} \quad (219)$$

$$W_{TBP} = 15.0 S_{BP} \quad (220)$$

where

$S_{AI}$  = auxiliary inlet panel area, ft<sup>2</sup>

$S_{BP}$  = by-pass door area, ft<sup>2</sup>

## ENGINE REMOVAL DOORS

Equation 221 is used to calculate engine removal doors weight. This item is calculated when door width is defined by user input. Door length is assumed to extend from the engine face to the end of the nacelle. Center of gravity is assumed to be located at half the door length.

$$WTED = 2.93 S_{ED}$$

(221)

where

$$S_{ED} = \text{engine removal door area, ft}^2$$

#### MISCELLANEOUS DOORS

Miscellaneous doors weight is calculated by equation 222 if door area is defined by the user. Center of gravity of this item is assumed to be located at half the nacelle length.

$$WTMD = 2.5 S_{MD}$$

(222)

where

$$S_{MD} = \text{miscellaneous doors area, ft}^2$$

#### FIREWALL

A firewall is located at engine front face station separating the combustion chamber from the inlet. Firewall surface area is calculated by subtracting the duct(s) cross-sectional area at the engine face from the nacelle cross-sectional area at the same location. The weight for this component is estimated at 0.8 pound per square foot.

#### EXTERIOR FINISH

Nacelle exterior finish is estimated at 0.026 pound per square foot of nacelle surface area and is located at half the nacelle length.

#### ENGINE COMPARTMENT SHROUD

The requirement of engine compartment shroud is defined by the user. Shroud surface area may be input or, if not available, calculated by equation 223. The shroud is assumed to extend from the engine face to the end of the nacelle.

$$S_{SD} = N L \left[ \frac{\pi}{2} (D + 5.0) + H \right] / 144 \quad (223)$$

where

$S_{SD}$  = shroud area,  $\text{ft}^2$

$N$  = number of engines in nacelle

$L$  = shroud length, in.

$D$  = maximum engine diameter, in.

$H$  = nacelle depth at engine front face, in.

Shroud weight to 0.8 pound per square foot and is assumed to be located at half the shroud length.

#### PYLONS AND NACELLE SUPPORT FITTINGS

Equation 224 is used to calculate pylon weight. Since inboard and outboard pylons may be different, separate calculations are performed for each pylon. The center of gravity is calculated by equation 225.

$$WTPI = 12.0 S_p \quad (224)$$

$$CG_p = CG_E + \frac{L}{2} \sin \Lambda_p \quad (225)$$

where

$S_p$  = pylon planform area,  $\text{ft}^2$

$CG_E$  = engine center of gravity, in.

$L$  = pylon length, in.

$\Lambda_p$  = sweep angle of pylon

Fittings (equation 226) at the pylon to wing or fuselage attach points are calculated according to the load and nacelle material properties.

$$\text{Fittings} = \text{Load} \left[ \frac{141.312 \rho}{F_{tu} + F_{cy}} + \frac{78.20 \rho}{F_{su} + F_{bru}} + 2.5 \times 10^{-5} \right] \quad (226)$$

where

$\rho$  = material density, lb/in.<sup>3</sup>

$F_{tu}$  = ultimate tensile strength, psi

$F_{cy}$  = compression yield strength, psi

$F_{su}$  = ultimate shear strength, psi

$F_{bru}$  = ultimate bearing strength, psi

The maximum load is determined by the vehicle maneuver load factor and yaw velocity. Equation 227 is used to determine the maximum load on vertical installations, and equation 228 for horizontal pylons.

$$\text{Load} = (N_z W_t + \dot{\psi}^2 Y b W_n / (12 G t)) \quad 1.5 \quad (227)$$

$$\text{Load} = (W_t + W_n b/t) \quad 1.5 N_z \quad (228)$$

where

$\dot{\psi}$  = vehicle yaw velocity, radians/sec

$N_z$  = vehicle vertical maneuver load factor

$W_t$  = weight of nacelle and contents plus pylon, lb

$W_n$  = weight of nacelle and contents, lb

$Y$  = lateral coordinate of nacelle installation, in.

$b$  = distance from the nacelle center to the tie point, in.

$t$  = maximum thickness of the pylon, in.

$G$  = acceleration of gravity, ft/sec<sup>2</sup>

## Section III

### PROGRAM DESCRIPTION

#### GENERAL DISCUSSION

The air induction system module has been developed to estimate weight of air induction system, nacelle, and engine section structure. Methods, equations, and logic discussed in the previous section have been programmed in FORTRAN extended language for the CDC 6600 computer. The module is structured in a single overlay consisting of a control program (AISMN) and 21 subroutines. One of the subroutines (MATLP2) is a material properties data print routine. Module weight summary results are printed by subroutine SUMARY as shown in Figures 3 through 5. Optional output of intermediate calculations are provided within individual data development routines.

Error messages, warning messages, and corrective measures have been built into the program such that most user errors will not result in catastrophic failure. In some cases, the warning is of a nature for which no user action is necessary. In other instances, incompatible data are either corrected, revised, or bypassed. The implications, probable cause, and recommended action associated with the various messages are presented in the subroutine discussions.

#### LOGIC FLOW

The module subroutine flow diagram is shown in Figure 21. System routines READMS and WRITMS are also shown in this diagram to indicate routines which read and store data in the mass storage file records. Figure 22 shows the logic flow diagram of this module. This diagram shows the major data manipulation and search procedures within this module.

#### GENERAL MAPS

Data storage and transmittal are accomplished through the use of blank common, labeled common, and mass storage file records. Mass storage file records are read into and written from data regions in common. Certain calculated variables are stored in the program region of individual routines. In this case, these variables are included in the discussion of the applicable routine.

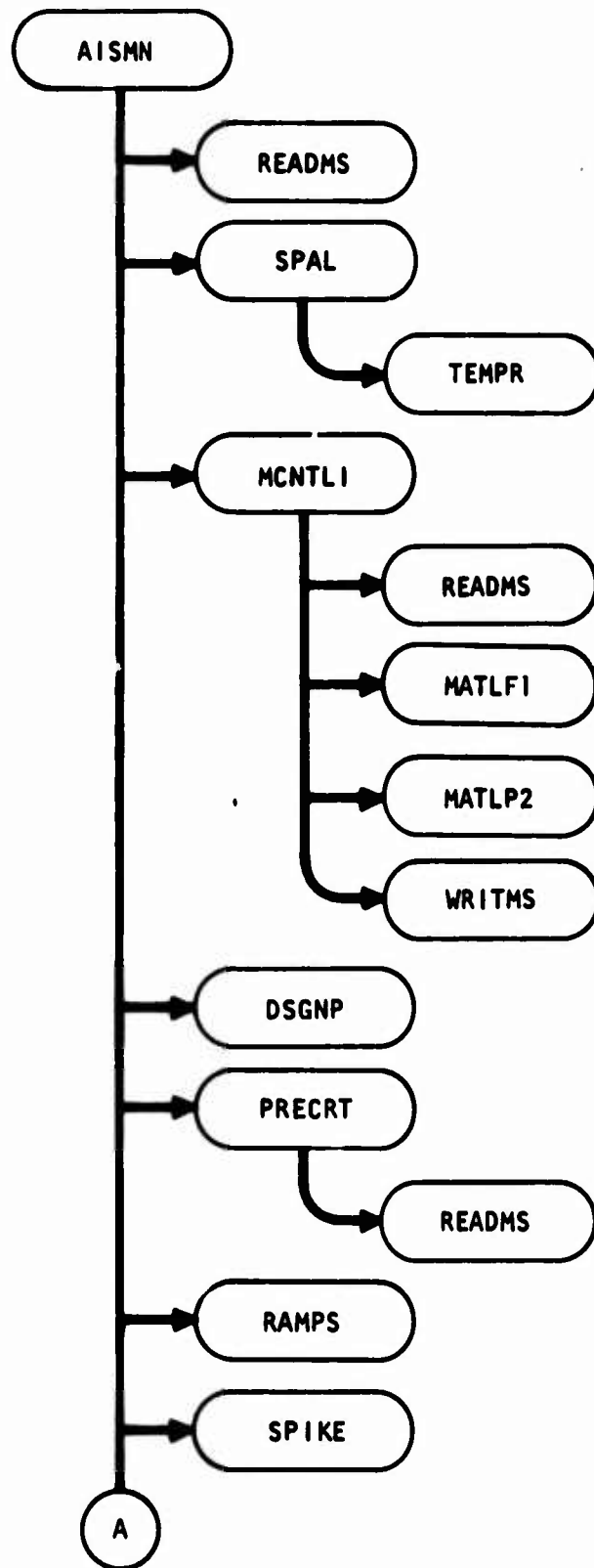


Figure 21. Air induction system module subroutine flow diagram, overlay (7,0).

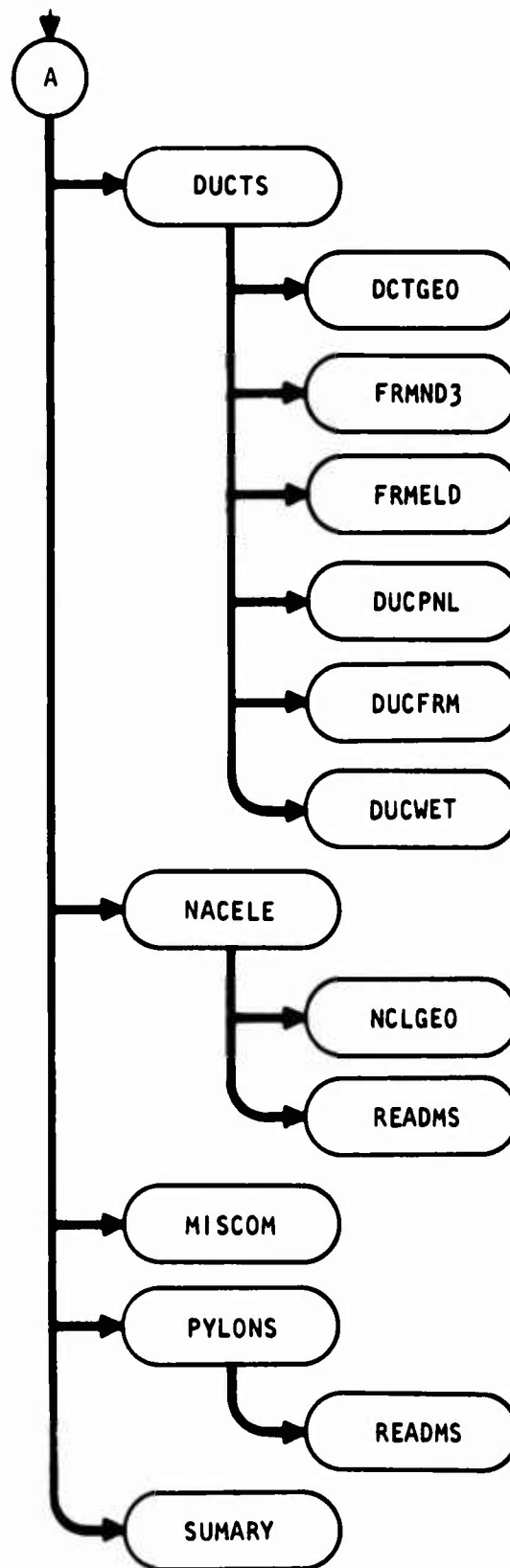


Figure 21. Air induction system module subroutine flow diagram, overlay (7,0) (concl).

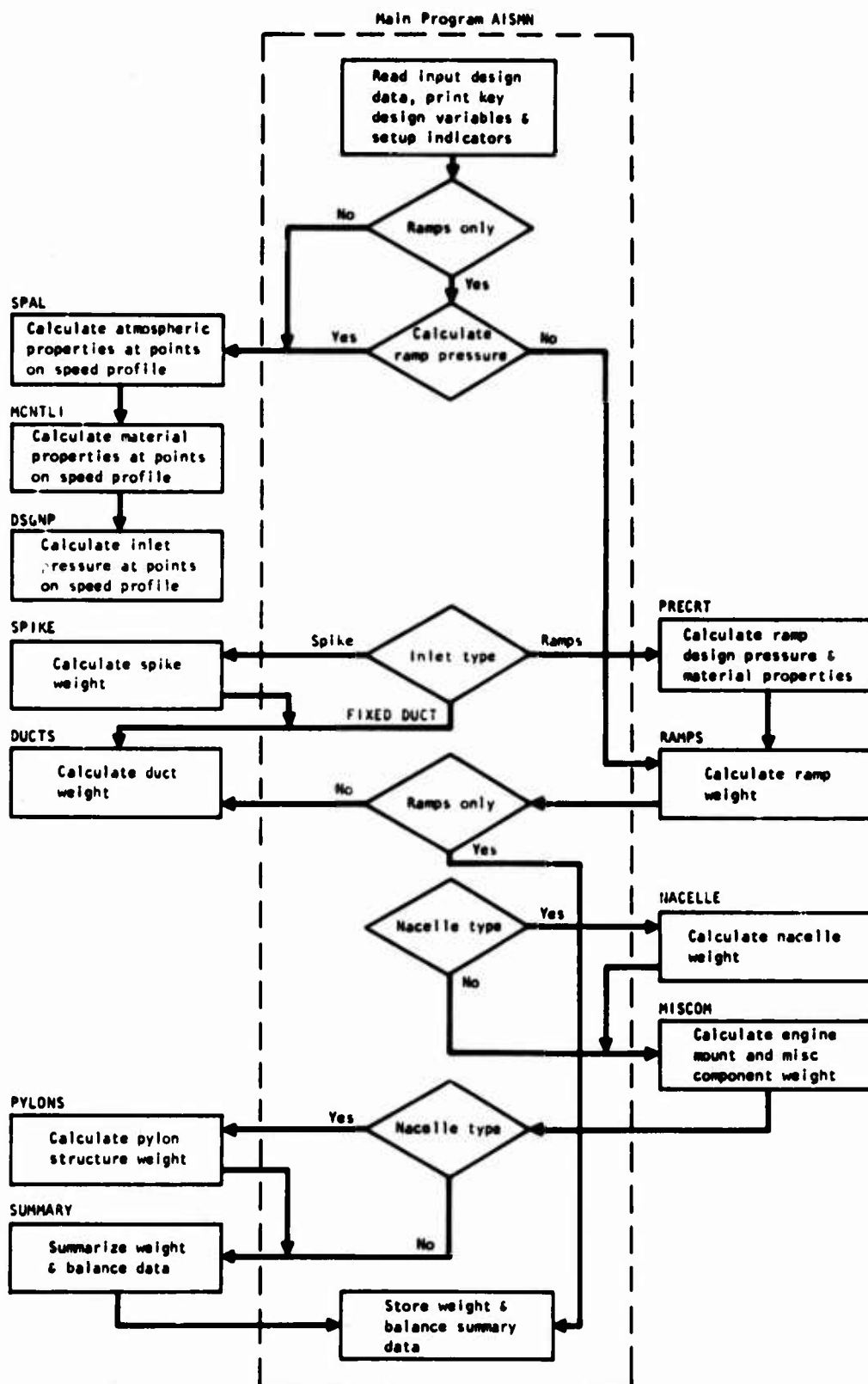


Figure 22. Logic flow diagram for air induction system module.

## COMMON

Blank common consists of 4,400 cells which are organized as shown in Table 9. Table 10 presents an alphabetical listing of arrays and variables within the common region. Items in the table are classified according to type as either input (I) or calculated (C). Many items that appear as calculated (C) variables may take on values that are input to the air induction system module. This is a function of whether or not default values or inputs are overridden in the synthesis procedure. However, items designated as input (I) types will always take on values that are input to this module. When variables in Table 10 are subsets of larger arrays, the higher order array is referenced in brackets.

Tables 11 through 25 are maps of those arrays that have specific significance which are not explained in the alphabetical listing.

## LABELED COMMON

Labeled common arrays are used to transfer program control words and certain vehicle design data.

- FDAT (Block FDATT) - This array is used to store air induction system, nacelle, and engine section (also other components) weight summary data for use in total vehicle summary calculations and output as shown in Table 26.
- IP (Block IPRINT) - This array is used to transmit print control indicators to various subroutines as shown in Table 27.
- XMISC (Block MISC) - The first location in this block is used to transmit the number of different materials which exist in the material library file records. Locations 85 through 100 are used to transmit alphanumeric case title information.

## MASS STORAGE FILE RECORDS

Mass storage file records used by this module are shown in Table 28. Variables in these records are discussed in the blank common region tables.

TABLE 9. COMMON ARRANGEMENT

Common Location	Variable Name and Locations	Variable Name and Locations	Variable Name and Locations	Detail Description Table Reference
1-80	D(1)-D(80)	DATK(1)-DATK(10)		11
81-270	EQU(1)-EQU(190)			17
271-280	EQU(191)-EQU(200)			17
281-320	DATS(1)-DATS(40)			16
321-400	DATD(1)-DATD(80)			12
401-520	DATR(1)-DATR(120)			16
521-600	DATN(1)-DATN(80)			14
601-640	DATM(1)-DATM(40)			13
641-733	DR(1)-DR(93)			15
734-770				Not used
771-1700	F(1)-F(930)			18
1701-1900	SUMM(1)-SUMM(200)			20
1901-2000				Not used
2001-2100	T(1)-T(100)	S(1)-S(100)		Refer to subrou- tine discussions
2101-2200	TOT(1)-TOT(100)			24
2201-2210	ALT(1)-ALT(10)			10
2211-2220	TEM(1)-TEM(10)			10
2221-2230	PO(1)-PO(10)			10
2231-2240	G(1)-G(10)			10
2241-2250	CS(1)-CS(10)			10
2251-2260	RHO(1)-RHO(10)			10
2261-2270	VII(1)-VII(10)			10
2271-2280	VL(1)-VL(10)			10
2281-2290	QH(1)-QH(10)			10
2291-2300	QL(1)-QL(10)			10
2301-2310	EMH(1)-EMH(10)			10
2311-2320	EML(1)-EML(10)			10
2321-2330	RATH(1)-RATH(10)			10
2331-2340	RATL(1)-RATL(10)			10
2341-2350	TEMH(1)-TEMH(10)			10
2351-2360	TEML(1)-TEML(10)			10
2361-2370	PTH(1)-PTH(10)			10
2371-2380	PTL(1)-PTL(10)			10
2381-2390	PSH(1)-PSH(10)			10
2391-2400	PSL(1)-PSL(10)			10
2401-2410	R1H(1)-R1H(10)			10
2411-2420	R1L(1)-R1L(10)			10
2421-2430	R2H(1)-R2H(10)			10
2431-2440	R2L(1)-R2L(10)			10
2441-2450	R3H(1)-R3H(10)			10

TABLE 9. COMMON ARRANGEMENT (CONT)

Common Location	Variable Name and Locations	Variable Name and Locations	Variable Name and Locations	Detail Description Table Reference
2451-2460	R3L(1)-R3L(10)	WTD(1)-WTD(10)		10
2461-2470	PHTH(1)-PHTH(10)			10
2471-2480	PHEH(1)-PHEH(10)			10
2481-2490	PHTL(1)-PHTL(10)			10
2491-2500	PHEL(1)-PHEL(10)			10
2501-2510	PST(1)-PST(10)			10
2511-2520	WOD(1)-WOD(10)			10
2521-2530	ROD(1)-ROD(10)			10
2531-2540	DOD(1)-DOD(10)			10
2541-2550	BUD(1)-BUD(10)			10
2551-2560	BLD(1)-BLD(10)			10
2561-2570	BSD(1)-BSD(10)			10
2571-2580	DLXD(1)-DLXD(10)			10
2581-2590	SFD(1)-SFD(10)			10
2591-2600	FTUH(1)-FTUH(10)			10
2601-2610	FTUL(1)-FTUL(10)			10
2611-2620	FCYH(1)-FCYH(10)			10
2621-2630	FCYL(1)-FCYL(10)			10
2631-2640	FSUH(1)-FSUH(10)			10
2641-2650	FSUL(1)-FSUL(10)			10
2651-2660	FMUH(1)-FMUH(10)			10
2661-2670	FMUL(1)-FMUL(10)			10
2671-2680	EH(1)-EH(10)			10
2681-2690	EL(1)-EL(10)			10
2691-2700	FKTH(1)-FKTH(10)			10
2701-2709	FKTL(1)-FKTL(9)			10
2710	FKTL(10)	RHOD		10
2711-2720	SFRM(1)-SFRM(10)			10
2721-2730	TC(1)-TC(10)			10
2731-2740	TL(1)-TL(10)			10
2741-2750	FRWT(1)-FRWT(10)			10
2751-2760	WON(1)-WON(10)			10
2761-2770	RON(1)-RON(10)			10
2771-2780	DON(1)-DON(10)			10
2781-2790	BUN(1)-BUN(10)			10
2791-2800	BLN(1)-BLN(10)			10
2801-2810	BSN(1)-BSN(10)			10
2811-2820	DLXN(1)-DLXN(10)			10
2821-2830	SFN(1)-SFN(10)			10
2831-2840	RCUN(1)-RCUN(10)			10
2841-2850	RCLN(1)-RCLN(10)			10

TABLE 9. COMMON ARRANGEMENT (CONCL)

Common Location	Variable Name and Locations	Variable Name and Locations	Variable Name and Locations	Detail Description Table Reference
2851-2860	RCSN(1)-RCSN(10)	RHON		10
2861-2869	ELN(1)-ELN(9)			10
2870	ELN(10)			10
2871-2880	TCN(1)-TCN(10)			10
2881-2890	SFRN(1)-SFRN(10)			10
2891-2900	FRWN(1)-FRWN(10)			10
2901-2910	WTCN(1)-WTCN(10)			10
2911-2920	WTFN(1)-WTFN(10)			10
2921-2930	WTLN(1)-WTLN(10)			10
2931-3020				Not used
3021-3080	DLSP(1)-DLSP(60)	AA(1)-AA(60)		10
3081-3140	BEN(1)-BEN(60)			10
3141-3200	VV(1)-VV(60)			10
3201-3260	TMD(1)-TMD(60)			22, 10
3261-3320	TMD(61)-TMD(120)			22, 10
3321-3380	TMD(121)-TMD(180)			22, 10
3381-3440	TMD(181)-TMD(240)			22, 10
3441-3500	TMD(241)-TMD(300)			22, 10
3501-3560	TM(1)-TM(60)			21, 10
3561-3621	TM(61)-TM(121)			21, 10
3622-3660	TM(122)-TM(160)	Z(1)-Z(39)		21, 10
3661-3682	TT(1)-TT(22)			25, 10
3683-3690	TT(23)-TT(30)			25, 10
3691-3743	TMS(1)-TMS(53)			23, 10
3744-3750	TMS(54)-TMS(60)			23, 10
3751-3804	TMS(61)-TMS(114)			23, 10
3805-3810	TMS(115)-TMS(120)			23, 10
3811-3865	TMS(121)-TMS(175)			23, 10
3866-3870	TMS(176)-TMS(180)			23, 10
3871-3926				10
3927-3987	BM(1)-BM(61)	A(1)-A(5) A(6)-A(61)	TWW(1)-TWW(53) TWW(54)-TWW(60) TCC(1)-TCC(54) TCC(55)-TCC(60) BB2(1)-BB2(55) BB2(56)-BB2(60)	10
3988-4100				Not used
4101-4200	DC(1)-DC(100)			Inactive
4201-4400	ND(1)-ND(200)			19

TABLE 10. COMMON REGION VARIABLE LIST

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
A	61	3866	C	Static lateral load at frame cuts, lb/(lb/in.)	FRMELD
AA	60	3201	C	Unit internal axial load at frame segment centroids, lb/(lb/in.)	DUCTS, FRMELD, DUCFRM
AACT	1	2131	C	Weight aft ramp actuator beam, lb (TOT)	RAMPS, AISW, PYLONS, SUMARY
AC	1	2058	C	Frame cap area, in. <sup>2</sup>	DUCFRM
ACT	1	2131	C	Weight aft ramp actuator beam, lb (TOT)	RAMPS, AISW, PYLONS, SUMARY
AHINGE	1	2132	C	Weight aft ramp hinge beam, lb (TOT)	RAMPS, AISW, PYLONS, SUMARY
ALOFT	1	2003	C	Altitude divided by 1,000, ft/1,000	TEMPR
ALPHA2	1	444	I	Angle between projected face of ramp 1 and ramp 2 for 2-ramp system, deg (DATR)	RAMPS
ALPHA3	1	467	I	Angle between projected face of ramp 2 and ramp 3 for 3-ramp system, deg (DATR)	RAMPS
ALT	10	2201	C	Nine altitudes on speed profile, ft	SPAL, TEMPR, DSGNP, PRECKT NACELE
AMI	1	2054	C	Minimum frame cap area, in. <sup>2</sup>	DUCFRM
BB2	60	3811	C	Frame cap width at frame segment centroids, in.	DUCTS, DUCFRM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
BC2	1	2062	C	Frame cap width, in.	DUCFRM
BEN	60	3081	C	Unit internal bending moment at frame segment centroids, in.-lb/(lb/in.)	DUCTS, FRMELD, DUCFRM
BLD	10	2551	C	Lower sector duct panel peripheral length at cuts, in.	DUCTS, DCTGEO
BLN	10	2791	C	Lower sector nacelle panel peripheral length at cuts, in.	NACELE, NCLGEO
BM	61	3927	C	Static bending moment at frame cuts, in.-lb/(lb/in.)	FRMELD
BMO	1	2043	C	Frame moment redundant, in.-lb/(lb/in.)	FRMELD
BSD	10	2561	C	Side sector duct panel peripheral length at cuts, in.	DUCTS, DCTGEO, DUCMET
BSN	10	2801	C	Side sector nacelle panel peripheral length at cuts, in.	NACELE, NCLGEO
BUD	10	2541	C	Upper sector duct panel peripheral length at cuts, in.	DUCTS, DCTGEO, DUCMET
BUN	10	2781	C	Upper sector nacelle panel peripheral length at cuts, in.	NACELE, NCLGEO

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
CONST	1	402	I	Construction indicator (DATR) 0.0 = standard 1.0 = honeycomb	RAMPS
CS	10	2241	C	Speed of sound at nine speed profile altitude, ft/sec	SPAL
D	2000	1	I	Constants (refer to Table 11)	Most
DADH	1	427	I	Adhesive density per honeycomb panel face sheet, psf (DATR)	RAMPS
DATD	80	321	I/C	Duct geometry and design data (refer to Table 12)	DUCTS, DCTGEO, DUCPNL, DUOMET, NACELE, MISCOM
DATK	10	271	I	Weight correlation constants (refer to EQU array, Table 17)	AISW, DUCTS, NACELE
DATM	40	601	I	Speed-altitude profile data (refer to Table 13)	SPAL
DATN	80	521	I/C	Nacelle geometry and design data (refer to Table 14)	NACELE, NCLGEO, MISCOM, PYLONS
DATR	120	401	I/C	Ramp geometry and design data (refer to Table 15)	AISW, RAMPS, DUOMET, SUMMARY

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
DATS	40	281	I	Air induction system, nacelle, and engine section design data (refer to Table 16)	ALSN, MCNTLI, SPIKE, DUCPNL, DUCFRM, NACELE, MISCOM, PYLONS, SUMMARY
DOORE	1	426	I	Honeycomb core density, lb/ft <sup>3</sup> (DATR)	RAMPS
DENS	1	414	I/C	Ramp material density, lb/in. <sup>3</sup> (DATR)	RAMPS, PRECRT
DLS	60	3381	C	Frame segment lengths at duct mold line, in.	FRMND3, FRMELD
DLSP	60	3021	C	Frame segment length at frame centroids, in.	FRMELD, DUCFRM
DLVG	1	631	I	General relationship between limit speed and level-flight maximum speed (DATM)	SPAL
DLXD	10	2571	C	Duct segment lengths between cuts, in.	DUCTS, DCTGEO, DUOMET
DLXN	10	2811	C	Nacelle segment lengths between cuts, in.	NACELE, NCLGEO
DOD	10	2531	C	Vertical flat length of duct contour at cuts, in.	DUCTS, DCTGEO, FRMND3, MISCOM
DON	10	2771	C	Vertical flat length of nacelle contour at cuts, in.	NACELE, NCLGEO, MISCOM
DR	93	641	I	Permanent ramp design constants (refer to Table 15)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
D1	1	1	I	Constant, 1.0 (refer to Table 11)	DUCFRM
D12	1	12	I	Constant, 12.0 (refer to Table 11)	DUCFRM
D2	1	2	I	Constant, 2.0 (refer to Table 11)	DUCFRM
E	1	2051	C	Frame material modulus of elasticity, psi	DUCFRM
EGTP	1	282	I	Engine type (refer to DATS array, Table 16)	DSGNP
EH	10	2671	C	Duct material modulus of elasticity on $M_H$ diagram, psi	MCNTL1, DUCPNL, DUCFRM
EL	10	2681	C	Duct material modulus of elasticity on $M_L$ diagram, psi	MCNTL1, DUCPNL, DUCFRM
ELN	10	2861	C	Nacelle material modulus of elasticity, psi	NACELE
EMH	10	2301	C	Airflow at engine on $M_H$ diagram, M	SPAL
EML	10	2311	C	Airflow at engine on $M_L$ diagram, M	SPAL
EQ	200	81	I	Equation and physical constants (refer to Table 17)	SPAL, TEMPR, DSGNP, MCNTL1, PRECXT, SPIKE, DUCPNL, DUOMET, NACELE, MISCOM, PYLONS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
F	930	771	I	Alphanumeric ramp parameter titles (refer to Table 18)	RAMPS
FACT	1	416	I/C	Limit to ultimate design factor (DATR)	PRECRT
FACT	1	2130	C	Weight forward ramp actuator beam, lb (TOT)	RAMPS
FCY	1	412	I/C	Ramp material compression yield stress at design pressure, psi (DATR)	RAMPS, PRECRT
FCY	1	2047	C	Duct frame material compression yield stress, psi	DUCFRM
FCYH	10	2611	C	Duct material compression yield stress on $M_H$ diagram, psi	MCNTL1, DUCFRM
FCYL	10	2621	C	Duct material compression yield stress on $M_L$ diagram, psi	MCNTL1, DUCFRM
FD	1	2041	C	Frame depth, in.	DUCTS, FRWELD, DUCFRM
FDAT	60	FDATT	C	Weight and balance summary (refer to Table 26)	AISN
RHINGE	1	2129	C	Weight forward ramp hinge beam, lb (TOT)	RAMPS
FKC	1	2053	C	Frame buckling coefficient	DUCFRM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
FKTH	10	2691	C	Duct material tensile strength under cyclic loading on $M_H$ diagram, fraction of ultimate tensile strength	MCNTL1, DUCPNL
FCTL	10	2701	C	Duct material tensile strength under cyclic loading on $M_L$ diagram, fraction of ultimate tensile strength	MCNTL1, DUCPNL
FMU	1	2050	C	Frame material Poisson's ratio	DUCFRM
FMH	10	2651	C	Duct material Poisson's ratio on $M_H$ diagram	MCNTL1, DUCFRM
FMJL	10	2661	C	Duct material Poisson's ratio on $M_L$ diagram	MCNTL1, DUCFRM
FRN	10	2891	C	Weight of one nacelle frame at nacelle cuts, lb	NACELE
FRWT	10	2741	C	Weight of one duct frame at duct cuts, lb	DUCTS, DUCFRM, NACELE
FSU	1	413	I/C	Ramp material ultimate shear strength at design pressure, psi (DATR)	RAMPS, PRECRT
FSU	1	2048	C	Frame material ultimate shear strength, psi	DUCFRM
FSUH	10	2631	C	Duct material ultimate shear strength on $M_H$ diagram, psi	MCNTL1, DUCFRM
FSUL	10	2641	C	Duct material ultimate shear strength on $M_L$ diagram, psi	MCNTL1, DUCFRM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
FTUH	10	2591	C	Duct material ultimate tensile strength on $M_H$ diagram, psi	MONTL1, DUCPNL
FTUL	10	2601	C	Duct material ultimate tensile strength on $M_L$ diagram, psi	MONTL1, DUCPNL
G	10	2231	C	Acceleration of gravity at nine speed profile altitudes, ft/sec <sup>2</sup>	SPAL
GAMMA	1	497	I	Angle between projected face of ramp 2 and ramp 3 for 4-ramp system, deg (DAIR)	RAMPS
HO	1	2044	C	Frame lateral load redundant, lb/(lb/in.)	FRMELD
I	1	4301	C	Scratch counter, also duct cut counter (ND)	most
IC	1	4320	C	Number of frame cuts (ND)	DUCTS, FRMELD
IGN	1	4325	C	Engine support-type indicator (ND) 0 = engine directly mounted to pylon or one engine per nacelle 1 = multiple engines per nacelle with engines mounted to nacelle structure	NACELE
ICNT	1	4328	C	Design pressure point counter (ND)	DUCFRM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
ICRT	1	4317	C	Critical design point on speed profile (ND)	PRECRT
IFF	1	4319	C	Number of frame segments (ND)	DUCTS, FRMND3, FRMELD, DUCFRM
IFRM	1	4321	C	Frame spacing search pass counter (ND) 1 = initial spacing pass 2 = second or subsequent spacing pass 3 = final or fixed spacing pass	DUCTS
IF3	1	4293	C	Material properties library file record number (ND)	MCNTL1
IF4	1	4294	C	Calculated material properties file record number (ND)	MCNTL1, PRECRT, NACELE, PYLONS
IGD	1	4314	C	Duct leading edge-type indicator (ND) 0 = complete section 1 = vertical lip 2 = horizontal lip	DUCTS, DCTGEO, DUCWET
IGN	1	4326	C	Nacelle leading edge-type indicator (ND) 0 = complete section 1 = vertical lip 2 = horizontal lip	NACELE, NCLGEO
II	1	4307	C	Counter through nine speed profile points (ND)	MCNTL1, MATLP2

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
IMIL		4322	C	Duct panel mill indicator (ND) 0 = panel not milled 1 = panel milled	DUCPNL
IP	80	IPRINT	I	Print controls (refer to Table 27)	<p> AISN, SPAL, DSGNP, MONTLL,  RAMPS, PRECCT, DUCTS, FRMELD,  NACELE, SUMARY </p>
IQ	1	4318	C	Number of frame segments per quadrant (ND)	DUCTS, FRAND3, FRMELD
ITP	1	4311	C	Number of nacelles (ND)	AISN
IVG	1	4312	C	Inlet-type indicator (ND) 1 = fixed duct 2 = fixed spike 3 = horizontal ramp 4 = vertical ramp 5 = translating spike 6 = translating and expanding spike	<p> AISN, DSGNP, MONTLL, SPIKE,  DUOMET, SUMARY </p>
J	1	4302	C	Scratch counter (ND)	most
JJ	1	4308	C	Counter for $M_H$ and $M_L$ at each speed profile altitude (ND)	MONTLL

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
K	1	4303	C	Scratch counter (ND)	Most
KC	1	4316	C	Duct perimeter code (ND) 1 = perimeter input 2 = perimeter correction factor input	DUCTS, DCTGEO
KCN	1	4324	C	Nacelle perimeter code (ND) 1 = perimeter input 2 = perimeter correction factor input	NACELE, NCLGEO
KK	1	4309	C	Scratch counter (ND)	MCNTLI, MATLP2, FRMND3, FRMELD
L	1	4304	C	Scratch counter, also duct cut counter (ND)	MCNTLI, DUCTS, FRMND3, FRMELD
MATLI	1	4260	C	Material identification number (ND)	MCNTLI, MATLP2
N	1	4306	C	Scratch counter (ND)	MCNTLI, MATLFI, MATLP2
NC	1	4315	C	Number of input duct cuts (ND)	DUCTS, DCTGEO, DUCPNL, DUCFRM, DUOMET, NACELE, MISCOM
NCN	1	4323	C	Number of input nacelle cuts (ND)	NACELE, NCLGEO, MISCOM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
ND	200	4201	C	Integer array (refer to Table 19)	ALL
NFLT	1	4327	C	Speed profile point critical for local panel flutter design (ND)	NACELE
NMATL	1	4259	C	Number of arrays of material properties in mass storage file, records 41 through 60 (ND)	AISN, MONTL
PAA	1	2057	C	Frame cap axial load from combined axial and bending load, lb	DUCFRM
PAX	1	2056	C	Frame axial load, lb	DUCFRM
PHEH	10	2471	C	Hammershock, pressure at engine on $M_H$ diagram, psia	DSGNP, DUCFRM
PHL	10	2491	C	Hammershock, pressure at engine on $M_L$ diagram, psia	DSGNP, DUCPNL, DUCFRM
PHS	1	403	I/C	Ultimate absolute hammershock pressure for ramp design, psia	RAMP, PRECCT
PHTH	10	2461	C	Hammershock pressure at throat on $M_H$ diagram, psia	DSGNP, PRECCT, DUCPNL, DUCFRM
PHTL	10	2481	C	Hammershock pressure at throat on $M_L$ diagram, psia	DSGNP, PRECCT, DUCPNL, DUCFRM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
PI	1	15	I	Constant, $\pi$ (refer to Table 11)	DUCFRM
PO	10	2221	C	Ambient pressure at nine speed profile altitudes, psf	SPAL, DUCPNL, DUCFRM
PRESH	1	2002	C	Ambient pressure at altitude, psf	SPAL, TEMPR
PSH	10	2381	C	Static absolute pressure at engine on $M_H$ diagram, psia	SPAL
PSL	10	2391	C	Static absolute pressure at engine on $M_L$ diagram, psia	SPAL, DUCPNL, DUCFRM
PST	10	2501	C	Static absolute pressure at throat on $M_L$ diagram, psia	DSGNP, DUCPNL, DUCFRM
PTH	10	2361	C	Total pressure at engine on $M_H$ diagram, psia	SPAL, DSGNP
PTL	10	2371	C	Total pressure at engine on $M_L$ diagram, psia	SPAL, DSGNP
QH	10	2281	C	Dynamic pressure on $M_H$ diagram, psf	SPAL
QL	10	2291	C	Dynamic pressure on $M_L$ diagram, psf	SPAL, NACELE

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
RATG	1	632	I	General pressure recovery ratio (DATM)	SPAL
RATH	10	2321	C	Inlet pressure recovery ratio on $M_H$ diagram	SPAL
RATL	10	2331	C	Inlet pressure recovery ratio on $M_L$ diagram	SPAL
RCLN	10	2841	C	Lower sector nacelle panel radius of curvature at cuts, in.	NCLGEO
RCSN	10	2851	C	Side sector nacelle panel radius of curvature at cuts, in.	NACELE, NCLGEO
RCIN	10	2831	C	Upper sector nacelle panel radius of curvature at cuts, in.	NACELE, NCLGEO
RHO	1	2052	C	Frame material density, lb/in. <sup>3</sup>	DUCFRM
RHO	10	2251	C	Density of air at nine speed profile altitudes, lb/ft <sup>3</sup>	SPAL
RHOD	1	2710	C	Duct material density, lb/in. <sup>3</sup>	MCNTL1, DUCPNL, DUCFRM, DUCNET
RHON	1	2870	C	Nacelle material density, lb/in. <sup>3</sup>	NACELE
RM	16	3485	I	Material descriptive title (refer to TMD array, Table 22)	MATLP2

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
ROD	10	2521	C	Corner radius of duct contour at cuts, in.	DUCTS, DCTGEO, FRAND3, MISCOM
RON	10	2761	C	Corner radius of nacelle contour at cuts, in.	NACELE, NCLGEO, MISCOM
RIH	10	2401	C	Ratio of static pressure at throat to free-stream total pressure on $M_H$ diagram	DSGNP
RLL	10	2411	C	Ratio of static pressure at throat to free-stream total pressure on $M_L$ diagram	DSGNP
RILONG	1	2124	C	Weight ramp 1 panel, 1b (TOT)	RAMPS
RITRAN	1	2125	C	Weight ramp 1 transverse beams, 1b (TOT)	RAMPS
R2H	10	2421	C	Ratio of hammer shock pressure at engine face to total pressure on $M_H$ diagram	DSGNP
R2L	10	2431	C	Ratio of hammer shock pressure at engine face to total pressure on $M_L$ diagram	DSGNP
R2LONG	1	2126	C	Weight ramp 2 panel, 1b (TOT)	RAMPS
R2TRAN	1	2127	C	Weight ramp 2 transverse beams, 1b (TOT)	RAMPS
R3H	10	2441	C	Ratio of hammer shock pressure at inlet throat to total pressure on $M_H$ diagram	DSGNP

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
R3L	10	2451	C	Ratio of hamershock pressure at inlet throat to total pressure on $M_L$ diagram	DSGNP
R3LONG	1	2128	C	Weight ramp 3 panel, lb (TOT)	RAMPS
R4LONG	1	2133	C	Weight ramp 4 panel, lb (TOT)	RAMPS
R4TRAN	1	2134	C	Weight ramp 4 transverse beams, lb (TOT)	RAMPS
S	100	2001	C	Intermediate calculations, refer to subroutine descriptions	SPAL, DSGNP, PRECRT, SPIKE, DUCTS, DCTGEO, FRAND3, FRWELD, DUCPNL, DUCFRM, DUCNET, NACELE, NCLGEO, MISCOM, PYLONS, SUMARY
SFD	10	2581	C	Surface area of duct segments, in. <sup>2</sup>	DUCTS, DCTGEO, DUCNET
SFN	10	2821	C	Surface area of nacelle segments, in. <sup>2</sup>	NACELE, NCLGEO
SFRM	10	2711	C	Duct frame spacing at duct cuts, in.	DUCTS, DUCPNL, DUCFRM, DUCNET, NACELE
SFRN	10	2881	C	Nacelle frame spacing at nacelle cuts, in.	NACELE
SIGA	1	498	I	Angle between projected face of ramp 3 and ramp 4 for 4-ramp system, deg (DATR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
SUM	200	1701	C	Weight and balance summary (refer to Table 20)	AI5W, SPIKE, DUCTS, NACELE, MISCOM, PYLONS, SUMMARY
T	2000	2001	C	Intermediate calculation	AI5W
TBARFA	1	502	I	Aluminum front panel minimum skin thickness, in. (DATR)	RAMP5
TBARFS	1	512	I	Steel front panel minimum skin thickness, in. (DATR)	RAMP5
TBARFT	1	507	I	Titanium front panel minimum skin thickness, in. (DATR)	RAMP5
TBARRA	1	503	I	Aluminum rear panel minimum skin thickness, in. (DATR)	RAMP5
TBARRS	1	513	I	Steel rear panel minimum skin thickness, in. (DATR)	RAMP5
TBARRT	1	508	I	Titanium rear panel minimum skin thickness, in. (DATR)	RAMP5
TC	10	2721	C	Duct panel field thickness at duct cuts, in.	DUCTS, DUCTNL, DUCMET

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
TCA	1	499	I	Aluminum minimum cap thickness, in. (DATR)	RAMPS
TCAP	1	2061	C	Frame cap thickness, in.	DUCFRM
TCAP2	1	2063	C	Half of frame cap thickness, in.	DUCFRM
TCC	60	3751	C	Frame cap thickness at frame segment centroids, in.	DUCTS, DUCFRM
TCN	10	2871	C	Nacelle panel thickness at nacelle cuts, in.	NACELE
TCS	1	509	I	Steel minimum cap thickness, in. (DATR)	RAMPS
TCT	1	504	I	Titanium minimum cap thickness, in. (DATR)	RAMPS
TEM	10	2211	C	Ambient temperature at nine speed profile altitudes, OR	SPAL
TEMALT	1	2001	C	Ambient temperature at altitude, OR	SPAL, TEMPR
TEMH	10	2341	C	Total temperature on $M_1$ diagram, OR	SPAL, DSGNP, MCNTL1, PRECRT
TEML	10	2351	C	Total temperature on $M_2$ diagram, OR	SPAL, DSGNP, MCNTL1, PRECRT
TEM2	1	2055	C	Intermediate calculation	DUCFRM
TL	10	2731	C	Duct panel land thickness at duct cuts, in.	DUCTS, DUCPNL, DUCWET

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
TM	160	3501	C	Calculated material data (refer to Table 21)	MCNTL1, MATLF1, MATLP2
TMD	300	3201	I	Material properties file record data (refer to Table 22)	MCNTL1, MATLF1, MATLP2
TMS	180	3691	C	Calculated material properties (refer to Table 23)	MCNTL1, PRECRT, NACELE, PYLONS
TOT	100	2101	C	Weight summary data (refer to Table 24)	AISN, DUCTS, DUCPNL, DUCNET, NACELE, MISCOM, PYLONS, SUMMARY
TOTAL	1	2120	C	Two-dimensional variable-geometry ramp structure weight, lb (TOT)	RAMPS
TSA	1	501	I	Aluminum honeycomb panel minimum face sheet thickness, in. (DATR)	RAMPS
TSS	1	511	I	Steel honeycomb panel minimum face sheet thickness, in. (DATR)	RAMPS
TST	1	506	I	Titanium honeycomb panel minimum face sheet thickness, in. (DATR)	RAMPS
TT	30	3661	C	Intermediate material properties calculations (refer to Table 25)	MCNTL1, MATLF1
TW	1	2059	C	Frame web thickness, in.	DUCFRM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
TWA	1	500	I	Aluminum web minimum thickness, in. (DATR)	RAMP
TWS	1	510	I	Steel web minimum thickness, in. (DATR)	RAMP
TWS	1	2060	C	Frame stiffener thickness, in.	DUCFRM
TWT	1	505	I	Titanium web minimum thickness, in. (DATR)	RAMP
TWT	1	2067	C	Frame weight, lb	DUCFRM
TWV	60	3691	C	Frame web thickness at frame segment centroids, in.	DUCTS, DUCFRM
ULD	240	3021		Unit loads (refer to DLSP, BEN, VV, and AA)	DUCTS, DUCFRM
V	61	3805	C	Static vertical load at frame cuts, lb/(lb/in.)	FRMELD
VH	10	2261	C	Level-flight maximum speed, $M_H$ , at nine speed profile altitudes, $M$	SPAL, DSGNP, PRECRT
VL	10	2271	C	Limit speed, $M_L$ , at nine speed profile altitudes, $M$	SPAL, DSGNP, PRECRT, NACELE
VO	1	2045	C	Frame vertical load redundant, lb/(lb/in.)	FRMELD

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
VV	60	3141	C	Unit internal shear at frame segment centroids, lb/(lb/in.)	DUCTS, FRMELD, DUCFRM
WFTI	1	2153	C	Weight inboard fittings, lb (TOT)	PYLONS
WFTO	1	2154	C	Weight outboard fittings, lb (TOT)	PYLONS
WFTS	1	2136	C	Weight translating spike, lb (TOT)	SPIKE
WHFS	1	2135	C	Weight fixed spike, lb (TOT)	SPIKE
WOD	10	2511	C	Horizontal flat length of duct contour at cuts, in.	DUCTS, DCTGEO, FRMND3, MISCOM
WON	10	2751	C	Horizontal flat length of nacelle contour at cuts, in.	NACELE, NCLGEO, MISCOM
WTAI	1	2141	C	Weight auxiliary inlets, lb (TOT)	MISCOM
WTBP	1	2142	C	Weight duct bypass doors, lb (TOT)	MISCOM
WTCN	10	2901	C	Nacelle panel weights within nacelle segments, lb	NACELE
WTD	10	2591	C	Duct segment weights, lb	DUCTS, DUCMET
WTED	1	2143	C	Weight engine removal doors, lb (TOT)	MISCOM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
WTEF	1	2147	C	Weight exterior finish, lb (TOT)	MISCOM
WTEM	1	2140	C	Weight engine mounts, lb (TOT)	MISCOM
WTES	1	2137	C	Weight translating and expanding spike, lb (TOT)	SPIKE
WTF	1	2064	C	Frame cap weight, lb	DUCFRM
WTFN	10	2911	C	Nacelle frame weights within nacelle segments, lb	NACELE
WTFW	1	2145	C	Weight firewall, lb (TOT)	MISCOM
WTILN	10	2921	C	Nacelle load redistribution member weights within nacelle segments, lb	NACELE
WTILP	1	2123	C	Weight inlet lip, lb (TOT)	DUCTS, DUCWET
WTMD	1	2144	C	Weight miscellaneous doors, lb (TOT)	MISCOM
WTPI	1	2151	C	Weight inboard pylon, lb (TOT)	PYLONS
WTPO	1	2152	C	Weight outboard pylon, lb (TOT)	PYLONS
WTSD	1	2146	C	Weight shroud, lb (TOT)	MISCOM
WTST	1	2066	C	Frame stiffener weight, lb	DUCFRM

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
WTW	1	2065	C	Frame web weight, lb	DUCFRM
W1	1	408	I	Width of ramp 1, in. (DATR)	RAMPS
W2	1	409	I	Width of ramp 2, in. (DATR)	RAMPS
W3	1	410	I	Width of ramp 3, in. (DATR)	RAMPS
W4	1	411	I	Width of ramp 4, in. (DATR)	RAMPS
XCL	1	421	I	Longitudinal bending couple correction factor, ratio of available to total beam depth (DATR)	RAMPS
XCT	1	425	I	Transverse bending couple correction factor, ratio of available to total beam depth (DATR)	RAMPS
XFCY	1	422	I	Ratio of allowable stress to compression yield stress (DATR)	RAMPS
XFSU	1	423	I	Ratio of allowable shear stress to ultimate shear strength (DATR)	RAMPS
XHTA2	1	443	I	Ratio of actuator beam depth to width of ramp 2 for 2-ramp system (DATR)	RAMPS
XHTA3	1	466	I	Ratio of actuator beam depth to width of ramp 3 for 3-ramp system (DATR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XHTA4	1	496	I	Ratio of actuator beam depth to width of ramp 4 for 4-ramp system (DATR)	RAMPS
XHT2	1	442	I	Ratio of panel depth to ramp width for 2-ramp system (DATR)	RAMPS
XHT3	1	465	I	Ratio of panel depth to ramp width for 3-ramp system (DATR)	RAMPS
XHT4	1	495	I	Ratio of panel depth to ramp width for 4-ramp system (DATR)	RAMPS
XH21	1	440	I	Depth to length ratio for ramp 1 of 2-ramp system (DATR)	RAMPS
XH22	1	441	I	Depth to length ratio for ramp 2 of 2-ramp system (DATR)	RAMPS
XH31	1	462	I	Depth to length ratio for ramp 1 of 3-ramp system (DATR)	RAMPS
XH32	1	463	I	Depth to length ratio for ramp 2 of 3-ramp system (DATR)	RAMPS
XH33	1	464	I	Depth to length ratio for ramp 3 of 3-ramp system (DATR)	RAMPS
XH41	1	491	I	Depth to length ratio for ramp 1 of 4-ramp system (DATR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XH42	1	492	I	Depth to length ratio for ramp 2 of 4-ramp system (DATR)	RAMP5
XH43	1	493	I	Depth to length ratio for ramp 3 of 4-ramp system (DATR)	RAMP5
XH44	1	494	I	Depth to length ratio for ramp 4 of 4-ramp system (DATR)	RAMP5
XIL21	1	428	I	Ramp 1 longitudinal beam weight index for 2-ramp system (DATR)	RAMP5
XIL22	1	431	I	Ramp 2 longitudinal beam weight index for 2-ramp system (DATR)	RAMP5
XIL31	1	445	I	Ramp 1 longitudinal beam weight index for 3-ramp system (DATR)	RAMP5
XIL32	1	448	I	Ramp 2 longitudinal beam weight index for 3-ramp system (DATR)	RAMP5
XIL33	1	451	I	Ramp 3 longitudinal beam weight index for 3-ramp system (DATR)	RAMP5
XIL41	1	468	I	Ramp 1 longitudinal beam weight index for 4-ramp system (DATR)	RAMP5
XIL42	1	471	I	Ramp 2 longitudinal beam weight index for 4-ramp system (DATR)	RAMP5

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XIL43	1	474	I	Ramp 3 longitudinal beam weight index for 4-ramp system (DATR)	RAMPS
XIL44	1	480	I	Ramp 4 longitudinal beam weight index for 4-ramp system (DATR)	RAMPS
XIM21	1	430	I	Ramp 1 minimum weight index for 2-ramp system (DATR)	RAMPS
XIM22	1	435	I	Ramp 2 minimum weight index for 2-ramp system (DATR)	RAMPS
XIM31	1	447	I	Ramp 1 minimum weight index for 3-ramp system (DATR)	RAMPS
XIM32	1	450	I	Ramp 2 minimum weight index for 3-ramp system (DATR)	RAMPS
XIM33	1	455	I	Ramp 3 minimum weight index for 3-ramp system (DATR)	RAMPS
XIM41	1	470	I	Ramp 1 minimum weight index for 4-ramp system (DATR)	RAMPS
XIM42	1	473	I	Ramp 2 minimum weight index for 4-ramp system (DATR)	RAMPS
XIM43	1	479	I	Ramp 3 minimum weight index for 4-ramp system (DATR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XIM44	1	482	I	Ramp 4 minimum weight index for 4-ramp system (DATR)	RAMPS
XITAA4	1	477	I	Ramp 3 aft actuator beam weight index for 4-ramp system (DATR)	RAMPS
XITAH2	1	434	I	Ramp 2 aft hinge beam weight index for 2-ramp system (DATR)	RAMPS
XITAH3	1	454	I	Ramp 3 aft hinge beam weight index for 3-ramp system (DATR)	RAMPS
XITAH4	1	478	I	Ramp 3 aft hinge beam weight index for 4-ramp system (DATR)	RAMPS
XITA2	1	433	I	Ramp 2 actuator beam weight index for 2-ramp system (DATR)	RAMPS
XITA3	1	453	I	Ramp 3 actuator beam weight index for 3-ramp system (DATR)	RAMPS
XITFA4	1	476	I	Ramp 3 fwd actuator beam weight index for 4-ramp system (DATR)	RAMPS
XITRH2	1	432	I	Ramp 2 fwd hinge beam weight index for 2-ramp system (DATR)	RAMPS
XITRH3	1	452	I	Ramp 3 fwd hinge beam weight index for 3-ramp system (DATR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XITH4	1	475	I	Ramp 3 fwd hinge beam weight index for 4-ramp system (DAIR)	RAMPS
XIT21	1	429	I	Ramp 1 transverse beam weight index for 2-ramp system (DAIR)	RAMPS
XIT31	1	446	I	Ramp 1 transverse beam weight index for 3-ramp system (DAIR)	RAMPS
XIT32	1	449	I	Ramp 2 transverse beam weight index for 3-ramp system (DAIR)	RAMPS
XIT41	1	469	I	Ramp 1 transverse beam weight index for 4-ramp system (DAIR)	RAMPS
XIT42	1	472	I	Ramp 2 transverse beam weight index for 4-ramp system (DAIR)	RAMPS
XIT44	1	481	I	Ramp 4 transverse beam weight index for 4-ramp system (DAIR)	RAMPS
XK21	1	438	I	Fraction of length of ramp 2 from front to reaction point for 2-ramp system (DAIR)	RAMPS
XK22	1	439	I	Fraction of length of ramp 2 from back to reaction point for 2-ramp system (DAIR)	RAMPS
XK31	1	459	I	Fraction of length of ramp 1 from front to reaction point for 3-ramp system (DAIR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XK32	1	460	I	Fraction of length of ramp 3 from front to reaction point for 3-ramp system (DATR)	RAMPS
XK33	1	461	I	Fraction of length of ramp 3 from back to reaction point for 3-ramp system (DATR)	RAMPS
XK41	1	487	I	Fraction of length of ramp 3 from front to reaction point for 4-ramp system (DATR)	RAMPS
XK42	1	488	I	Fraction of length of ramp 3 between reaction points for 4-ramp system (DATR)	RAMPS
XK43	1	489	I	Fraction of length of ramp 3 from back to reaction point for 4-ramp system (DATR)	RAMPS
XK44	1	490	I	Fraction of length of ramp 1 from front to reaction point for 4-ramp system (DATR)	RAMPS
XL1	1	404	I	Length of ramp 1, in. (DATR)	RAMPS
XL2	1	405	I	Length of ramp 2, in. (DATR)	RAMPS
XL3	1	406	I	Length of ramp 3, in. (DATR)	RAMPS
XL4	1	407	I	Length of ramp 4, in. (DATR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XMAT	1	415	I	Material type indicator (DATR) 1 = aluminum 2 = titanium 3 = steel	RAMPS, PRECRT
XMISC	160	MISC	I	Number of material file records and alphanumeric case title	ALSMN, SPAL, RAMPS, DUCTS, NACELE, SUMARY
XNUM	1	401	I	Number of ramps (DATR)	RAMPS
XO	10	331	I	Duct cut stations, in. (refer to DATD array, Table 12)	DUCPNL, DUCFRM, DUCWET
XP21	1	436	I	Fraction of ultimate hamershock pressure on ramp 1 of 2-ramp system (DATR)	RAMPS
XP22	1	437	I	Fraction of ultimate hamershock pressure on ramp 2 of 2-ramp system (DATR)	RAMPS
XP31	1	456	I	Fraction of ultimate hamershock pressure on ramp 1 of 3-ramp system (DATR)	RAMPS
XP32	1	457	I	Fraction of ultimate hamershock pressure on ramp 2 of 3-ramp system (DATR)	RAMPS
XP33	1	458	I	Fraction of ultimate hamershock pressure on ramp 3 of 3-ramp system (DATR)	RAMPS

TABLE 10. COMMON REGION VARIABLE LIST (CONT)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
XP41	1	483	I	Fraction of ultimate hammershock pressure on ramp 1 of 4-ramp system (DATR)	RAMP5
XP42	1	484	I	Fraction of ultimate hammershock pressure on ramp 2 of 4-ramp system (DATR)	RAMP5
XP43	1	485	I	Fraction of ultimate hammershock pressure on ramp 3 of 4-ramp system (DATR)	RAMP5
XP44	1	486	I	Fraction of ultimate hammershock pressure on ramp 4 of 4-ramp system (DATR)	RAMP5
XW	1	424	I	Fraction of ramp width for transverse beam reaction points (DATR)	RAMP5
Y	61	3561	C	Y-coordinate of frame cuts at duct mold line, in.	FRAND3, FRMELD
YB	60	3261	C	Y-centroid of frame segments at duct mold line, in.	FRAND3, FRMELD
YP	61	3683	C	Y-coordinate of frame neutral axis at cuts, in.	FRMELD
YPB	60	3441	C	Y-centroid of frame segments at neutral axis, in.	FRMELD

TABLE 10. COMMON REGION VARIABLE LIST (CONCL)

Var Name	Size	Common Loc	Type	Description	Subroutine Reference
Z	61	3622	C	Z-coordinate of frame cuts at duct mold line, in.	FRAND3, FRMELD
ZB	60	3521	C	Z-centroid of frame segments at duct mold line, in.	FRAND3, FRMELD
ZERO	1	24	I	Constant, 0.0 (refer to Table 11)	DUCFRM
ZP	61	3744	C	Z-coordinate of frame segment at neutral axis, in.	FRMELD
ZPB	60	3501	C	Z-centroid of frame segments at neutral axis, in.	FRMELD
ZZS	1	2042	C	Z-centroid of elastic center, in.	FRMELD

TABLE 11. D ARRAY VARIABLES

Loc	Variable Name	Value	Description	Subroutine Reference
1	D1	1.0	Constant	Most
2	D2	2.0	Constant	Most
3		3.0	Constant	Most
4		4.0	Constant	MATLF1, NACELE, MISCOM
5		5.0	Constant	
6		6.0	Constant	
7		7.0	Constant	
8		8.0	Constant	DCTGEO, NCLGEO
9		9.0	Constant	
10		10.0	Constant	NACELE, PYLONS
11		11.0	Constant	
12		12.0	Constant	DUCFRM, PYLONS
13		20.0	Constant	
14		1000.0	Constant	TEMPR, DUCTS
15	PI	3.1415927	Constant, PI	Most
16		0.01745324	Constant, PI/180	PYLONS
17		144.0	Constant	Most
18		24.0	Constant	
19		0.5	Constant	DUCFRM
20		1.5	Constant	
21		0.333333	Constant	DUCFRM, NACELE
22		0.95	Constant	
23		0.25	Constant	
24		0.0	Constant	Most
25	ZERO	1.414214	Constant, square root of 2	NCLGEO
26		32.17405	Constant, acceleration of gravity, Ft/sec <sup>2</sup>	SPAL, PYLONS
27		180.0	Constant	
28		1.732051	Constant, square root of 3	MATLF1
29		2.5	Constant	
30		1.333333	Constant	
31		0.5	Increment for frame spacing search, in.	DUCTS
32			Not used	
●			To	
38			Not used	

TABLE 11. D ARRAY VARIABLES (CONT)

Loc	Variable Name	Value	Description	Subroutine Reference
39		1.5	Limit to ultimate factor for hammer-shock at $M_H$ , static pressure at $M_L$ , and basic loads	PRECRT, DUCPNL, DUCFRM, PYLONS
40		1.2	Limit to ultimate factor for hammer-shock at $M_L$	PRECRT, DUCPNL DUCFRM
41		5.0	Number of frame segments per quadrant (15 maximum)	DUCTS
42		0.426	Flange crippling coefficient, one edge free	DUCFRM
43		4.0		
44		7.5	Shear crippling coefficient for flat panels	DUCFRM
45		1.0		
46		0.9	Reduction factor for frame cap compression yield allowable	DUCFRM
47		0.75		
48		0.005	One gage increment to webs for frame stiffeners, in.	DUCFRM
49		2.0	Land width for frame attach, in.	DUCPNL, DUCWET
50		2.0		
51		0.050	Minimum land thickness for panel, in.	DUCPNL
52		0.032	Minimum field thickness for panel, in.	DUCPNL, NACELE
53		0.145		
54		0.050	Minimum frame cap thickness, in.	DUCFRM

TABLE 11. D ARRAY VARIABLES (CONCL)

Loc	Variable Name		Description	Subroutine Reference
55		0.032	Minimum frame web thickness, in.	DUCFRM
56		1.0	Minimum frame flange width, in.	DUCFRM, NACELE
57		0.050	Minimum nacelle frame cap thickness, in.	NACELE
58		0.025	Minimum nacelle frame web thickness, in.	NACELE
59		1.0		
60		0.9		
61		0.875		
62		0.3263434		
63		0.050		
64			Not used	
•			To	
80			Not used	
81			Refer to Table 9	
2000				
NOTE D array starts at common location 1.				

TABLE 12. DATD DUCT INPUT DATA ARRAY VARIABLES

Loc	Variable Name	Description	Subroutine Reference
1		NCD, number of cuts through duct	DUCTS
2		KCD, duct geometry-type indicator 1.0 = perimeter input 2.0 = perimeter correction factor input	DUCTS
3		Not used	
4		Frame depth, in.	DUCTS
5		Minimum frame spacing, in.	DUCTS
6		Maximum frame spacing, in.	DUCTS
7		Duct panel mill indicator 0.0 = panel not milled 1.0 = panel milled (lands at frames)	DUCPNL
8		Not used	
•		To	
10		Not used	
11	X0(1)	X-station, duct cut 1 referenced from leading edge station (loc 11 = 0.0), in.	DUCTS, DCTGEO, DUCPNL, DUCFRM, DUCWET, NACELE, MISCOM
•	•	To	
20	X0(10)	X-station, duct cut 10, in.	
21		Y-station, duct cut 1, in. Distance from centerline of vehicle to centerline of duct for fuselage - buried engine concept, or distance from centerline of nacelle to centerline of duct for nacelle - mounted engines	DCTGEO, DUCWET, NACELE, MISCOM
•		To	
30		Y-station, duct cut 10, in.	
31		Not used	
•		To	
40		Not used	
41		Duct depth at duct cut 1, in.	DUCTS, DCTGEO
•		To	
50		Duct depth at duct cut 10, in.	

TABLE 12. DATD DUCT INPUT DATA ARRAY VARIABLES (CONCL)

Loc	Variable Name	Description	Subroutine Reference
51		Duct width at duct cut 1, in.	DUCTS DCTGEO
•		To	
60		Duct width at duct cut 10, in.	DUCTS, DCTGEO, DUCPNL,
61		Duct perimeter, in., or perimeter correction factor at duct cut 1	
•		To	
70		Duct perimeter, in., or perimeter correction factor at duct cut 10	
71		Not used	
•		To	
80		Not used	

NOTE DATD array starts at common location 321.

TABLE 13. DATM ARRAY VARIABLES

Loc	Variable Name	Description
1		Level-flight maximum speed ( $M_H$ ) at sea level with wing fixed or aft, M
•		To
5		Level-flight maximum speed at maximum altitude with wing fixed or aft, M
6		Sea-level altitude with wing fixed or aft, ft
•		To
10		Maximum altitude with wing fixed or aft, ft
11		Increment from level-flight maximum speed to limit speed ( $M_L$ ) at sea level
		0.0 = use general increment in location 31
		<1.0 = decimal increment to add to $M_H$
		>1.0 = multiplier for $M_H$
		<0.0 + fraction of $M_H$ to add to $M_H$
•		To
15		Increment from level-flight maximum speed to limit speed at maximum altitude
16		Inlet pressure recovery ratio at $M_H$ at sea level
•		To
20		Inlet pressure recovery ratio at $M_H$ at maximum altitude

TABLE 13. DATM ARRAY VARIABLES (CONCL)

Loc	Variable Name	Description
21	DVLG  RATG	Inlet pressure recovery ratio at $M_L$ at sea level
•		To
25		Inlet pressure recovery ratio at $M_L$ at maximum altitude
26		Airflow at engine at sea level, M
•		To
30		Airflow at engine at maximum altitude, M
31		General increment from level-flight maximum speed to limit speed
32		General inlet pressure recovery ratio
33		Not used
•		To
40		Not used

NOTE    DATM array starts at common location 601.

TABLE 14. DATN NACELLE DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	NCN, number of nacelle cuts	NACELE
2	KCN, nacelle geometry-type indicator 1 = perimeter input 2 = perimeter correction factor input	NACELE
3	ICN, engine mounting type 0 = engine supported directly by pylons 1 = engine supported by nacelle structure which is tied to pylons	NACELE
4	Not used	
5	Not used	
6	Nacelle frame spacing, in.	NACELE
7	Nacelle frame depth, in.	NACELE
8	Engine access door(s) width, in.	NACELE, MISCOM
9	Nacelle maximum depth, in.	PYLONS
10	Nacelle maximum width, in.	PYLONS
11	X-station nacelle cut 1 referenced from leading edge station (loc 11 = 0.0), in. To	NACELE, NCLGEO, MISCOM
20	X-station duct cut 10, in.	
21	Not used To	
40	Not used	
41	Nacelle depth at nacelle cut 1, in. To	NACELE, NCLGEO, MISCOM
50	Nacelle depth at nacelle cut 10, in.	
51	Nacelle width at nacelle cut 1, in. To	NACELE, NCLGEO
60	Nacelle width at nacelle cut 10	
61	Nacelle perimeter, in., or perimeter correction factor at nacelle cut 1 To	NACELE, NCLGEO
70	Nacelle perimeter, in., or perimeter correction factor at nacelle cut 10	
71	Mach number for critical panel flutter, M	NACELE
72	Altitude that corresponds to critical panel flutter mach number, ft	NACELE

TABLE 14. DATN NACELLE DATA ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
73	Dynamic pressure that corresponds to critical mach number, psf	NACELE
74	Nacelle panel modulus of elasticity at critical flutter condition, psi	NACELE
75	Function of mach number for critical flutter condition	NACELE
76	Not used	
	To	
80	Not used	
NOTE DATN array starts at common location 521.		

TABLE 15. DATR AND DR ARRAY VARIABLES

DATR Array		DR Array		Description	Subroutine Reference <sup>a</sup>
Loc	Variable Name	Loc	Value		
1	XNUM			Number of ramps	DUCWET, SUMMARY
2	CONST			Construction indicator 0.0 = standard construction 1.0 = honeycomb construction	
3	PHS			Ultimate absolute hammershock pressure (refer to loc 18), psia	PRECRT
4	XL1			Length of ramp 1, in.	DUCWET, SUMMARY
5	XL2			Length of ramp 2, in.	DUCWET, SUMMARY
6	XL3			Length of ramp 3, in.	DUCWET, SUMMARY
7	XL4			Length of ramp 4, in.	DUCWET, SUMMARY
8	W1			Width of ramp 1, in.	
9	W2			Width of ramp 2, in.	
10	W3			Width of ramp 3, in.	
11	W4			Width of ramp 4, in.	
12	FCY			Compression yield stress of ramp material (refer to loc 18), psi	PRECRT
13	FSU			Ultimate shear stress of ramp material (refer to loc 18), psi	PRECRT
14	DENS			Density of ramp material (refer to loc 18), lb/in. <sup>3</sup>	PRECRT
15	XMAT			Material-type indicator 1.0 = aluminum 2.0 = titanium 3.0 = steel	PRECRT
16	FACT or FCT			Factor of safety (limit to ultimate factor) (refer to loc 18)	PRECRT
17				Distance from leading edge of duct to first ramp hinge, in.	DUCWET, SUMMARY
18				Design definition indicator 1.0 = locations 3, 12-16 are specified in input data set 0.0 = calculate data required in locations 3, 12-16	AIMN
19				Calculation indicator 1.0 = calculate ramp weights only 0.0 = calculate all component weights	AIMN

TABLE 15. DATR AND DR ARRAY VARIABLES (CONT)

DATR Array		DR Array		Description	Subroutine Reference <sup>a</sup>
Loc	Variable Name	Loc	Value		
20				Not used	
21	XCL	1	0.9	Ratio of effective height between axial members to total panel depth (stiffened sheet construction only)	
22	XFCY	2	0.5	Ratio of allowable compression stress to compression yield stress (stiffened sheet construction only)	
23	XFSU	3	0.5	Ratio of allowable shear stress to ultimate shear strength (stiffened sheet construction only)	
24	XW	4	0.25	Ratio of hinge position from panel edge to panel width ( $0.25 \leq XW \leq 0.5$ )	
25	XCT	5	0.9	Ratio of effective height between transverse beam caps to total beam depth (stiffened sheet construction only)	
26	DCORE	6	4.4	Honeycomb core density, lb/ft <sup>3</sup>	
27	DADH	7	0.1	Adhesive density per honeycomb panel facesheet, psf	
DATR locations 28 through 44 contain data for two-ramp system					
28	XIL21	8	1.0	Ramp 1 panel weight correlation factor	
29	XIT21	9	1.0	Ramp 1 hinge beam weight correlation factor	
30	XIM21	10	1.0	Ramp 1 minimum weight correlation factor	
31	XIL22	11	1.0	Ramp 2 panel weight correlation factor	
32	XITFH2	12	1.0	Ramp 2 forward hinge beam weight correlation factor	
33	XITA2	13	1.0	Ramp 2 actuator beam weight correlation factor	
34	XITAH2	14	1.0	Ramp 2 aft hinge beam weight correlation factor	

TABLE 15. DATR AND DR ARRAY VARIABLES (CONT)

DATR Array		DR Array		Description	Subroutine Reference <sup>a</sup>
Loc	Variable Name	Loc	Value		
35	XIM22	15	1.0	Ramp 2 minimum weight correlation factor	
36	XP21	16	0.5	Differential pressure on ramp 1, fraction of ultimate hammer shock pressure	
37	XP22	17	0.4	Differential pressure on ramp 1, fraction of ultimate hammer shock pressure	
38	XK21	18	0.2	Fraction of length of ramp 2 from forward edge to actuator location	
39	XK22	19	0.8	Fraction of length of ramp 2 from aft edge to actuator location	
40	XH21	20	0.1	Panel depth to length ratio for ramp 1	
41	XH22	21	0.07	Panel depth to length ratio for ramp 2	
42	XHT2	22	0.1	Panel depth to width ratio for each ramp	
43	XHTA2	23	0.15	Actuator beam depth to panel width ratio for ramp 2	
44	ALPHA2	24	30.0	Angle between projected face of ramp 1 and ramp 2, deg	
DATR locations 45 through 67 contain data for three-ramp system					
45	XIL31	25	1.0	Ramp 1 panel weight correlation factor	
46	XIT31	26	1.0	Ramp 1 transverse beam weight correlation factor	
47	XIM31	27	1.0	Ramp 1 minimum weight correlation factor	
48	XIL32	28	1.0	Ramp 2 panel weight correlation factor	
49	XIT32	29	1.0	Ramp 2 transverse beam weight correlation factor	
50	XIM32	30	1.0	Ramp 2 minimum weight correlation factor	

TABLE 15. DATR AND DR ARRAY VARIABLES (CONT)

DATR Array		DR Array		Description	Subroutine Reference <sup>a</sup>
Loc	Variable Name	Loc	Value		
51	XIL33	31	1.0	Ramp 3 panel weight correlation factor	
52	XIFFH3	32	1.0	Ramp 3 forward hinge beam weight correlation factor	
53	XITA3	33	1.0	Ramp 3 actuator beam weight correlation factor	
54	XITAH3	34	1.0	Ramp 3 aft hinge beam weight correlation factor	
55	XIM33	35	1.0	Ramp 3 minimum weight correlation factor	
56	XP31	36	0.2	Differential pressure on ramp 1, fraction of ultimate hammershock pressure	
57	XP32	37	0.5	Differential pressure on ramp 2, fraction of ultimate hammershock pressure	
58	XP33	38	0.4	Differential pressure on ramp 3, fraction of ultimate hammershock pressure	
59	XK31	39	0.9	Fraction of length of ramp 1 from forward edge to actuator location	
60	XK32	40	0.2	Fraction of length of ramp 3 from forward edge to actuator location	
61	XK33	41	0.8	Fraction of length of ramp 3 from aft edge to actuator location	
62	XH31	42	0.2	Panel depth to length ratio for ramp 1	
63	XH32	43	0.1	Panel depth to length ratio for ramp 2	
64	XH33	44	0.07	Panel depth to length ratio for ramp 3	
65	XH3	45	0.1	Panel depth to width ratio for each ramp	
66	XHFA3	46	0.15	Actuator beam depth to panel width ratio for ramp 3	
67	ALPIA3	47	30.0	Angle between projected face of ramp 2 and ramp 3, deg	
DATR locations 68 through 98 contain data for four-ramp system					

TABLE 15. DATR AND DR ARRAY VARIABLES (CONT)

DATR Array		DR Array		Description	Subroutine Reference <sup>a</sup>
Loc	Variable Name	Loc	Value		
68	XIL41	48	1.0	Ramp 1 panel weight correlation factor	
69	XIT41	49	1.0	Ramp 1 transverse beam weight correlation factor	
70	XIM41	50	1.0	Ramp 1 minimum weight correlation factor	
71	XIL42	51	1.0	Ramp 2 panel weight correlation factor	
72	XIT42	52	1.0	Ramp 2 transverse beam weight correlation factor	
73	XIM42	53	1.0	Ramp 2 minimum weight correlation factor	
74	XIL43	54	1.0	Ramp 3 panel weight correlation factor	
75	XITFH4	55	1.0	Ramp 3 forward hinge beam weight correlation factor	
76	XITFA4	56	1.0	Ramp 3 forward actuator beam weight correlation factor	
77	XITAA4	57	1.0	Ramp 3 aft actuator beam weight correlation factor	
78	XITAH4	58	1.0	Ramp 3 aft hinge beam weight correlation factor	
79	XIM43	59	1.0	Ramp 3 minimum weight correlation factor	
80	XIL44	60	1.0	Ramp 4 panel weight correlation factor	
81	XIT44	61	1.0	Ramp 4 transverse beam weight correlation factor	
82	XIM44	62	1.0	Ramp 4 minimum weight correlation factor	
83	XP41	63	0.6	Differential pressure on ramp 1, fraction of ultimate hammershock pressure	
84	XP42	64	1.0	Differential pressure on ramp 2, fraction of ultimate hammershock pressure	
85	XP43	65	1.0	Differential pressure on ramp 3, fraction of ultimate hammershock pressure	

TABLE 15. DATR and DR ARRAY VARIABLES (CONT)

DATR Array		DR Array		Description	Subroutine Reference <sup>a</sup>
Loc	Variable Name	Loc	Value		
86	XP44	66	0.4	Differential pressure on ramp 4, fraction of ultimate hammer shock pressure	
87	XK41	67	0.1	Fraction of length of ramp 3 from forward edge to forward actuator location	
88	XK42	68	0.75	Fraction of length of ramp 3 distance between actuators	
89	XK43	69	0.15	Fraction of length of ramp 3 from aft edge to aft actuator location	
90	XK44	70	0.9	Fraction of length of ramp 1 from forward edge to actuator location	
91	XH41	71	0.1	Panel depth to length ratio for ramp 1	
92	XH42	72	0.1	Panel depth to length ratio for ramp 2	
93	XH43	73	0.08	Panel depth to length ratio for ramp 3	
94	XH44	74	0.1	Panel depth to length ratio for ramp 4	
95	XHT4	75	0.1	Panel depth to width ratio for each ramp	
96	XHTA4	76	0.125	Actuator beam depth to panel width ratio for ramp 3	
97	GAMMA	77	20.0	Angle between projected face of ramp 2 and ramp 3, deg	
98	SIGMA	78	10.0	Angle between projected face of ramp 3 and ramp 4, deg	
DATR locations 99 through 113 contain minimum gage data					
99	TCA	79	0.04	Aluminum cap thickness, in.	
100	TWA	80	0.02	Aluminum web thickness, in.	
101	TSA	81	0.015	Aluminum honeycomb face sheet thickness, in.	
102	TBARFA	82	0.04	Aluminum front sheet thickness, in.	
103	TBARRA	83	0.015	Aluminum rear sheet thickness, in.	
104	TCT	84	0.025	Titanium cap thickness, in.	
105	TWT	85	0.013	Titanium web thickness, in.	

TABLE 15. DATR AND DR ARRAY VARIABLES (CONCL)

DATR Array		DR Array		Description	Subroutine Reference <sup>a</sup>
Loc	Variable Name	Loc	Value		
106	TST	86	0.01	Titanium honeycomb face sheet thickness, in.	
107	TBARFT	87	0.025	Titanium front sheet thickness, in.	
108	TBARAT	88	0.01	Titanium rear sheet thickness, in.	
109	TCS	89	0.02	Steel cap thickness, in.	
110	TWT	90	0.01	Steel web thickness, in.	
111	TST	91	0.01	Steel honeycomb face sheet thickness, in.	
112	TBARFS	92	0.02	Steel front sheet thickness, in.	
113	TBARAS	93	0.01	Steel rear sheet thickness, in.	
114				Not used	
.				To	
120				Not used	
NOTE DATR array starts at common location 401, DR array starts at common location 641. If DATR values are not defined in the input data set, DR values are transferred to the corresponding DATR locations.					
<sup>a</sup> All variables in these arrays, with the exception of DATR(17), DATR(18), and DATR(19), are used in subroutine RAMPS. DR array is only used in subroutine RAMPS.					

TABLE 16. DATS ENGINE SECTION AND AIR INDUCTION  
SYSTEM INPUT DATA ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	IPT, number of nacelles	AIMN, MISCOM, PYLONS SUMARY
2	EGTP, engine bypass ratio	AIMN, DSGNP
3	IVG, inlet type 1.0 = fixed duct 2.0 = fixed spike 3.0 = horizontal ramp 4.0 = vertical ramp 5.0 = translating spike 6.0 = translating and <sub>2</sub> expanding spike	AIMN
4	Capture area per inlet, in. <sup>2</sup>	AIMN, SPIKE
5	Number of Inlets	AIMN, SPIKE
6	Distance, leading edge of inlet to throat, in.	AIMN, SPIKE, DUCPNL, DUCFRM
7	Number of engines per vehicle	AIMN, NACELE, MISCOM, PYLONS
8	Maximum sea-level static thrust per engine, lb.	AIMN
9	Weight per engine, lb	AIMN, MISCOM, PYLONS
10	Engine length, in.	AIMN
11	Engine maximum diameter, in.	AIMN, MISCOM
12	Distance from front face to engine center of gravity, in.	AIMN, MISCOM
13	X-station inlet leading edge of inboard engine package, in.	AIMN, SUMARY
14	Y-station inboard nacelle centerline at engine front face, in.	AIMN, PYLONS
15	Z-station inboard nacelle centerline at engine front face, in.	AIMN
16	X-station inlet leading edge of outboard engine package, in.	AIMN, SUMARY
17	Y-station outboard nacelle centerline at engine front face, in.	AIMN, PYLONS
18	Z-station outboard nacelle centerline at engine front face, in.	AIMN
19	Not used	
20	Pylon, sweep of leading edge, deg	AIMN, PYLONS

TABLE 16. DATS ENGINE SECTION AND AIR INDUCTION  
SYSTEM INPUT DATA ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
21	Pylon type of mounting 0 = vertical 1 = horizontal	AIMN, PYLONS
22	Pylon, chord of inboard, in.	AIMN, PYLONS
23	Pylon, span of inboard, in.	AIMN, PYLONS
24	Pylon, chord of outboard, in.	AIMN, PYLONS
25	Pylon, span of outboard, in.	AIMN, PYLONS
26	Pylon, thickness to chord ratio	AIMN, PYLONS
27	Auxiliary inlet door area per nacelle, ft <sup>2</sup>	AIMN, MISCOM
28	Duct bypass door area per nacelle, ft <sup>2</sup>	AIMN, MISCOM
29	Miscellaneous door area per nacelle, ft <sup>2</sup>	AIMN, MISCOM
30	Shroud indicator 0.0 = no shroud 1.0 = shroud >1.0 = shroud area, ft <sup>2</sup>	AIMN, MISCOM
31	Duct structural material identification number	AIMN, MCNTL1
32	Variable-geometry ramps structural material identification number	AIMN, MCNTL1
33	Nacelle structural material identification number	AIMN, MCNTL1
34	Not used	
35	Not used	
36	Yaw velocity, radian/sec	AIMN, PYLONS
37	Maximum vertical maneuver load factor	AIMN, PYLONS
NOTE DATS array starts at common location 281.		

TABLE 17. EQU ARRAY VARIABLES

Loc	Value	Description	Subroutine Reference
1	36.08924	Altitude, 1,000 ft	TEMPR
2	2116.22	Ambient pressure at sea level, psf	TEMPR
3	0.00687559	Curve fit constant	TEMPR
4	5.25591	Curve fit constant	TEMPR
5	65.61688	Altitude, 1,000 ft	TEMPR
6	20.80556	Curve fit constant	TEMPR
7	472.68	Ambient pressure at 36,089 ft, psf	TEMPR
8	104.9869	Altitude, 1,000 ft	TEMPR
9	114.345	Ambient pressure at 65,617 ft, psf	TEMPR
10	389.97	Curve fit constant	TEMPR
11	-34.1634	Curve fit constant	TEMPR
12	0.548641	Curve fit constant	TEMPR
13	18.131	Ambient pressure at 104,987 ft, psf	TEMPR
14	1.53619	Curve fit constant	TEMPR
15	411.57	Ambient temperature at 104,987 ft, ° R	TEMPR
16	-12.2012	Curve fit constant	TEMPR
17	154.19948	Altitude, 1,000 ft	TEMPR
18	518.67	Ambient temperature at sea level, ° R	TEMPR
19	3.56616	Curve fit constant	TEMPR
20	389.97	Ambient temperature between 36,089 and 65,617 ft, ° R	TEMPR
21	0.00000304	Curve fit constant	SPAL
22	53.3	Gas constant, ft-lb/lb/° R	SPAL
23	1.4	Ratio of specific heats	SPAL
24	0.075	Constant-pressure recovery calculation	SPAL
25	1.35	Constant-pressure recovery calculation	SPAL
26	0.3	Constant airflow at engine, M	SPAL
27	0.5	Constant airflow at engine, M	SPAL
28	460.0	Conversion ° R to ° F	MCNTL1, PRECRT
29	12.53	Fixed spike weight estimate constant	SPIKE
30	15.65	Translating spike weight estimate constant	SPIKE
31	51.8	Translating and expanding spike estimate constant	SPIKE
32	0.8	Constant-static-pressure calculation	DSGNP
33	0.05	Constant-static-pressure calculation	DSGNP
34	400.0	Constant-hammershock pressure calculation	DSGNP
35	1.019056	Constant-hammershock pressure calculation	DSGNP

TABLE 17. EQU ARRAY VARIABLES (CONT)

Loc	Value	Description	Subroutine Reference
36	0.0289156	Constant-hammershock pressure calculation	DSGNP
37	1.350112	Constant-hammershock pressure calculation	DSGNP
38	0.664319	Constant-hammershock pressure calculation	DSGNP
39	1.5	Constant-hammershock pressure calculation	DSGNP
40	0.00602627	Constant-hammershock pressure calculation	DSGNP
41	0.080725	Constant-hammershock pressure calculation	DSGNP
42	3.16503	Constant-hammershock pressure calculation	DSGNP
43	1.588524	Constant-hammershock pressure calculation	DSGNP
44	1100.0	Constant-hammershock pressure calculation	DSGNP
45	2.5	Constant-hammershock pressure calculation	DSGNP
46	0.770476	Constant-hammershock pressure calculation	DSGNP
47	0.1482515	Constant-hammershock pressure calculation	DSGNP
48	4.371758	Constant-hammershock pressure calculation	DSGNP
49	2.114969	Constant-hammershock pressure calculation	DSGNP
50	900.0	Constant-hammershock pressure calculation	DSGNP
51	1.538116	Constant-hammershock pressure calculation	DSGNP
52	0.3029697	Constant-hammershock pressure calculation	DSGNP
53	0.4872335	Constant-hammershock pressure calculation	DSGNP
54	0.4653126	Constant-hammershock pressure calculation	DSGNP
55	700.0	Constant-hammershock pressure calculation	DSGNP

TABLE 17. EQU ARRAY VARIABLES (CONT)

Loc	Value	Description	Subroutine Reference
56		Not used	
.		To	
60		Not used	
61	1.6	Constant-hammershock pressure calculation	DSGNP
62	0.984	Constant-hammershock pressure calculation	DSGNP
63	0.0074	Constant-hammershock pressure calculation	DSGNP
64	0.0263	Constant-hammershock pressure calculation	DSGNP
65		Not used	
.		To	
80		Not used	
81	0.03	Maximum ratio of deflection to frame spacing at inlet throat (deflection criteria), in./in.	DUCPNL
82	0.06	Maximum ratio of deflection to frame spacing aft of inlet throat (deflection criteria), in./in.	DUCPNL
83	0.071853	Panel deflection equation constant for pressure loading	DUCPNL
84	0.666667	Panel deflection equation constant for pressure loading	DUCPNL
85	2.666667	Panel deflection equation constant for pressure loading	DUCPNL
86	1.666667	Panel deflection equation constant for pressure loading	DUCPNL
87	1.3769	Panel thickness at midspan equation constant for pressure loading	DUCPNL
88	2.484	Panel thickness at midspan equation constant for pressure loading	DUCPNL
89	1.984	Panel thickness at midspan equation constant for pressure loading	DUCPNL
90	4.467	Panel thickness at midspan equation constant for pressure loading	DUCPNL
91	1.646	Panel thickness at edge equation constant for pressure loading	DUCPNL
92	0.894	Panel thickness at edge equation constant for pressure loading	DUCPNL

TABLE 17. EQU ARRAY VARIABLES (CONT)

Loc	Value	Description	Subroutine Reference
93	0.394	Panel thickness at edge equation constant for pressure loading	DUCPNL
94	1.288	Panel thickness at edge equation constant for pressure loading	DUCPNL
95	2.5	Maximum land thickness to field thickness ratio	DUCPNL
96	4.0	Duct lip unit weight, psf	DUCWET
97	0.4851674	Constant for calculation of flutter parameter, function of mach number	NACELE
98	1.166456	Constant for calculation of flutter parameter, function of mach number	NACELE
99	0.488412	Constant for calculation of flutter parameter, function of mach number	NACELE
100	0.4037203	Constant for calculation of flutter parameter, function of mach number	NACELE
101	1.4	Constant for calculation of flutter parameter, function of mach number	NACELE
102	0.6	Constant for calculation of flutter parameter, function of mach number	NACELE
103	0.484927	Constant for calculation of flutter parameter, function of mach number	NACELE
104	0.555184	Constant for calculation of cover flutter thickness parameter	NACELE
105	0.1686944	Constant for calculation of cover flutter thickness parameter	NACELE
106	0.02169992	Constant for calculation of cover flutter thickness parameter	NACELE
107	0.000963694	Constant for calculation of cover flutter thickness parameter	NACELE
108	12.0	Pylon unit weight, psf	PYLONS
109	141.3125	Fitting weight calculation parameter	PYLONS
110	78.2	Fitting weight calculation parameter	PYLONS
111	0.000025	Fitting weight calculation parameter	PYLONS
112	0.015	Engine mount weight estimate factor, fraction of engine weight	MISCOM
113	12.0	Auxiliary inlet door unit weight, psf	MISCOM
114	15.0	Duct bypass door unit weight, psf	MISCOM
115	2.93	Engine removal door unit weight, psf	MISCOM
116	2.5	Miscellaneous doors unit weight, psf	MISCOM
117	0.8	Firewalls and shrouds unit weight, psf	MISCOM

TABLE 17. EQU ARRAY VARIABLES (CONCL)

Loc	Value	Description	Subroutine Reference
118	5.0	Engine compartment clearance constant, in.	MISCOM
119	0.026	Unit weight of exterior finish, psf	MISCOM
120	1.0	Nacelle load redistribution structure unit weight, psf	NACELE
121		Not used	
.		To	
190		Not used	
191	1.0	DATK (1), Duct weight index factor	AISMN, DUCTS
192	1.0	DATK (2), Nacelle frame weight index factor	AISMN, NACELE
193	1.0	DATK (3), Nacelle cover weight index factor	AISMN, NACELE
194	1.0	DATK (4), Nacelle longitudinal members weight index factor	AISMN, NACELE
195		DATK (5), Not used	
.		To	
200		DATK (10), Not used	
NOTE EQU array starts at common location 81.			

TABLE 18. F ARRAY RAMP TITLES

Locations	Title Data	Used With AIS Data Loc
1 - 10	21 CL	421
11 - 20	22 PERCENT OF COMPRESSION YIELD	422
21 - 30	23 PERCENT OF SHEAR ULTIMATE	423
31 - 40	24 XW	424
41 - 50	25 CT	425
51 - 60	26 DENSITY OF CORE (PSF)	426
61 - 70	27 DENSITY OF ADHESIVE (PSF)	427
71 - 80	28 INDEX RAMP 1 LONGITUDINAL	428
81 - 90	29 INDEX RAMP 1 TRANSVERSE	429
91 - 100	30 INDEX RAMP 2 MINIMUM GAGE	430
101 - 110	31 INDEX RAMP 2 LONGITUDINAL	431
111 - 120	32 INDEX RAMP 2 FWD HINGE BEAM	432
121 - 130	33 INDEX RAMP 2 ACTUATOR BEAM	433
131 - 140	34 INDEX RAMP 2 AFT HINGE BEAM	434
141 - 150	35 INDEX RAMP 2 MINIMUM GAGE	435
151 - 160	36 PERCENT HAMMERSHOCK RAMP 1	436
161 - 170	37 PERCENT HAMMERSHOCK RAMP 2	437
171 - 180	38 K21	438
181 - 190	39 K22	439
191 - 200	40 H21	440
201 - 210	41 H22	441
211 - 220	42 HT2	442
221 - 230	43 HTA2	443
231 - 240	44 ANGLE RAMP 1 - RAMP 2	444
241 - 250	45 INDEX RAMP 1 LONGITUDINAL	445
251 - 260	46 INDEX RAMP 1 TRANSVERSE	446
261 - 270	47 INDEX RAMP 1 MINIMUM GAGE	447
271 - 280	48 INDEX RAMP 2 LONGITUDINAL	448
281 - 290	49 INDEX RAMP 2 TRANSVERSE	449
291 - 300	50 INDEX RAMP 2 MINIMUM GAGE	450
301 - 310	51 INDEX RAMP 3 LONGITUDINAL	451
311 - 320	52 INDEX RAMP 3 FWD HINGE BEAM	452
321 - 330	53 INDEX RAMP 3 ACTUATOR BEAM	453
331 - 340	54 INDEX RAMP 3 AFT HINGE BEAM	454
341 - 350	55 INDEX RAMP 3 MINIMUM GAGE	455
351 - 360	56 PERCENT HAMMERSHOCK RAMP 1	456
361 - 370	57 PERCENT HAMMERSHOCK RAMP 2	457
371 - 380	58 PERCENT HAMMERSHOCK RAMP 3	458
381 - 390	59 K31	459
391 - 400	60 K32	460
401 - 410	61 K33	461

TABLE 18. F ARRAY RAMP TITLES (CONT)

Locations	Title Data	Used With AIS Data Loc
411 - 420	62 H31	462
421 - 430	63 H32	463
431 - 440	64 H33	464
441 - 450	65 HT3	465
451 - 460	66 HTA3	466
461 - 470	67 ANGLE RAMP 2 - RAMP 3	467
471 - 480	68 INDEX RAMP 1 LONGITUDINAL	468
481 - 490	69 INDEX RAMP 1 TRANSVERSE	469
491 - 500	70 INDEX RAMP 1 MINIMUM GAGE	470
501 - 510	71 INDEX RAMP 2 LONGITUDINAL	471
511 - 520	72 INDEX RAMP 2 TRANSVERSE	472
521 - 530	73 INDEX RAMP 2 MINIMUM GAGE	473
531 - 540	74 INDEX RAMP 3 LONGITUDINAL	474
541 - 550	75 INDEX RAMP 3 FWD HINGE BEAM	475
551 - 560	76 INDEX RAMP 3 FWD ACTUATOR BEAM	476
561 - 570	77 INDEX RAMP 3 AFT ACTUATOR BEAM	477
571 - 580	78 INDEX RAMP 3 AFT HINGE BEAM	478
581 - 590	79 INDEX RAMP 3 MINIMUM GAGE	479
591 - 600	80 INDEX RAMP 4 LONGITUDINAL	480
601 - 610	81 INDEX RAMP 4 TRANSVERSE	481
611 - 620	82 INDEX RAMP 4 MINIMUM GAGE	482
621 - 630	83 PERCENT HAMMERSHOCK RAMP 1	483
631 - 640	84 PERCENT HAMMERSHOCK RAMP 2	484
641 - 650	85 PERCENT HAMMERSHOCK RAMP 3	485
651 - 660	86 PERCENT HAMMERSHOCK RAMP 4	486
661 - 670	87 K41	487
671 - 680	88 K42	488
681 - 690	89 K43	489
691 - 700	90 K44	490
701 - 710	91 H41	491
711 - 720	92 H42	492
721 - 730	93 H43	493
731 - 740	94 H44	494
741 - 750	95 HT4	495
751 - 760	96 HTA4	496
761 - 770	97 ANGLE RAMP 2 - RAMP 3	497
771 - 780	98 ANGLE RAMP 3 - RAMP 4	498
781 - 790	99 ALUMINUM TC	499
791 - 800	100 ALUMINUM TW	506
801 - 810	101 ALUMINUM TS	507
811 - 820	102 ALUMINUM TBARF	508

TABLE 18. F ARRAY RAMP TITLES (CONCL)

Locations	Title Data	Used With AIS Data Loc
821 - 830	103 ALUMINUM TBARR	509
831 - 840	104 TITANIUM TC	510
841 - 850	105 TITANIUM TW	511
851 - 860	106 TITANIUM TS	512
861 - 870	107 TITANIUM TBARF	513
871 - 880	108 TITANIUM TBARR	514
881 - 890	109 STEEL TC	515
891 - 900	110 STEEL TW	516
901 - 910	111 STEEL TS	517
911 - 920	112 STEEL TBARF	518
921 - 930	113 STEEL TBARR	519
NOTE F array starts at common location 771.		

TABLE 19. ND ARRAY VARIABLES

Loc	Variable Name	Description	Subroutine Reference
1		Not used	
.		To	
58		Not used	
59	NMATL	Number of arrays of material properties in mass storage file, records 41 through 60	AIMN,MCNTL1
60	MATLI	Material identification number	MCNTL1,MATLP2
61		Not used	
.		To	
92		Not used	
93	IF3	Material properties library file record number	MCNTL1
94	IF4	Calculated material properties file record number	MCNTL1,PRECRT, NACELE, PYLONS
95		Not used	
.		To	
100		Not used	
101	I	Scratch counter, also duct cut counter in routines referenced	DUCTS,DUCPNL, DUCFRM
102	J	Scratch counter	Most
103	K	Scratch counter	Most
104	L	Scratch counter, also duct cut counter in routines referenced	DUCTS,FRMND3, FRMELD
105		Not used	
106	N	Scratch counter	MCNTL1,MATLF1, MATLP2
107	II	Counter through nine speed profile points	MCNTL1,MATLP2
108	JJ	Counter for $M_H$ and $M_L$ at each speed profile altitude	MCNTL1
109	KK	Scratch counter	MCNTL1,MATLP2, FRMND3,FRMELD
110		Not used	
111	ITP	Number of nacelles	AIMN
112	IVG	Inlet-type indicator 1 = fixed duct 2 = fixed spike 3 = horizontal ramp 4 = vertical ramp 5 = translating spike 6 = translating and expanding spike	AIMN,DSGNP, MCNTL1,SPIKE, DUCWET,SUMARY

TABLE 19. ND ARRAY VARIABLES (CONT)

Loc	Variable Name	Description	Subroutine Reference
113	IGD	Not used	DUCTS,DCTGEO, DUCWET
114		Duct leading edge-type indicator 0 = complete section 1 = vertical lip 2 = horizontal lip	
115	NC	Number of input duct cuts	DUCTS,DCTGEO, DUCPNL,DUCFRM, DUCWET,NACELE, MISCOM
116	KC	Duct perimeter code 1 = perimeter input 2 = perimeter correction factor input	DUCTS,DCTGEO
117	ICRT	Critical design point on speed profile	PRECRT
118	IQ	Number of frame segments per quadrant	DUCTS,FRMND3, FRMELD
119	IFF	Number of frame segments	DUCTS,FRMND3, FRMELD,DUCFRM
120	IC	Number of frame cuts	DUCTS,FRMELD, DUCTS
121	IFRM	Frame spacing search pass counter 1 = initial spacing 2 = second or subsequent spacing 3 = final or fixed spacing	
122	IMIL	Duct panel mill indicator 0 = panel not milled 1 = panel milled	DUCPNL
123	NCN	Number of input nacelle cuts	NACELE,NCLGEO, MISCOM
124	KCN	Nacelle perimeter code 1 = perimeter input 2 = perimeter correction factor input	NACELE,NCLGEO

TABLE 19. ND ARRAY VARIABLES (CONCL)

Loc	Variable Name	Description	Subroutine Reference
125	ICN	Engine support-type indicator 0 = engine directly mounted to pylon or one engine per nacelle 1 = multiple engines per nacelle with engines mounted to nacelle structure	NACELE
126	IGN	Nacelle leading edge-type indicator 0 = complete section 1 - vertical lip 2 = horizontal lip	NACELE,NCLGEO
127	NFLT	Speed profile point critical for local panel flutter design	NACELE
128	ICNT	Design pressure point counter	DUCFRM
129		Not used	
.		To	
200		Not used	
NOTE: ND array starts at common location 4201.			

TABLE 20. SUMM ARRAY VARIABLES

Loc	Description	Subroutine Reference
1	Weight air induction system structure per vehicle, lb	SUMARY, AISMN
2	X-CG air induction system structure, in.	SUMARY, AISMN
3	Weight duct lip, per nacelle in DUCTS, per vehicle in SUMARY, lb	DUCTS, SUMARY
4	X-CG duct lip, relative to inlet leading edge in DUCTS, in vehicle system in SUMARY, in.	DUCTS, SUMARY
5	Weight duct, per nacelle in DUCTS, per vehicle in SUMARY, lb	DUCTS, SUMARY
6	X-CG duct, relative to inlet leading edge in DUCTS, in vehicle system in SUMARY, in.	DUCTS, SUMARY
7	Weight auxiliary inlet, per nacelle in MISCOM, per vehicle in SUMARY, lb	MISCOM, SUMARY
8	X-CG auxiliary inlet, relative to inlet leading edge in MISCOM, in vehicle system in SUMARY, in.	MISCOM, SUMARY
9	Weight duct by pass doors, per nacelle in MISCOM, per vehicle in SUMARY, lb	MISCOM, SUMARY
10	X-CG duct bypass doors, relative to inlet leading edge in MISCOM, in vehicle system in SUMARY, in.	MISCOM, SUMARY
11	Weight two-dimensional variable-geometry ramp structure per vehicle, lb	SUMARY
12	X-CG ramp structure, in.	SUMARY
13	Weight fixed spike, per nacelle in SPIKE, per vehicle in SUMARY, lb	SPIKE, SUMARY
14	X-CG fixed spike, relative to inlet leading edge in SPIKE, in vehicle system in SUMARY, in.	SPIKE, SUMARY
15	Weight translating spike, per nacelle in SPIKE, per vehicle in SUMARY, lb	SPIKE, SUMARY
16	X-CG translating spike, relative to inlet leading edge in SPIKE, in vehicle system in SUMARY, in.	SPIKE, SUMARY
17	Weight translating and expanding spike, per nacelle in SPIKE, per vehicle in SUMARY, lb	SPIKE, SUMARY

TABLE 20. SUMM ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
18	X-CG translating and expanding spike, relative to inlet leading edge in SPIKE, in vehicle system in SUMARY, in.	SPIKE, SUMARY
19	Not used	
20	Not used	
21	Weight engine mounts, per nacelle in MISCOM, per inboard engine package in SUMARY, 1b	MISCOM, SUMARY
22	X-CG engine mounts, relative to inlet leading edge in MISCOM and PYLONS, in vehicle system in SUMARY, in.	MISCOM, PYLONS, SUMARY
23	Weight engine mounts in outboard nacelle set, 1b	SUMARY
24	X-CG outboard nacelle engine mounts, in.	SUMARY
25	Weight nacelle frames, per nacelle in NACELE, per inboard engine package in SUMARY, 1b	NACELE, SUMARY
26	X-CG nacelle frames, relative to inlet leading edge in NACELE, in vehicle system in SUMARY, in.	NACELE, SUMARY
27	Weight nacelle frames in outboard nacelle set, 1b	SUMARY
28	X-CG outboard nacelle frames, in.	SUMARY
29	Weight nacelle covers, per nacelle in NACELE, per inboard engine package in SUMARY, 1b	NACELE, SUMARY
30	X-CG nacelle covers, relative to inlet leading edge in NACELE, in vehicle system in SUMARY, in.	NACELE, SUMARY
31	Weight nacelle frames in outboard nacelle set, 1b	SUMARY
32	X-CG outboard nacelle covers, in.	SUMARY
33	Weight nacelle longitudinal members, per nacelle in NACELE, per inboard engine package in SUMARY, 1b	NACELE, SUMARY
34	X-CG nacelle longitudinal members, relative to inlet leading edge in NACELE, in vehicle system in SUMARY, in.	NACELE, SUMARY

TABLE 20. SUMM ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
35	Weight nacelle longitudinal members in outboard nacelle set, 1b	SUMARY
36	X-CG outboard nacelle longitudinal members, in.	SUMARY
37	Weight inboard fittings per nacelle in PYLONS, per inboard nacelle set in SUMARY, 1b	PYLONS, SUMARY
38	X-CG inboard fittings, relative to inlet leading edge in PYLONS, in vehicle system in SUMARY, in.	PYLONS, SUMARY
39	Weight outboard fittings per nacelle in PYLONS, per outboard nacelle set in SUMARY, 1b	PYLONS, SUMARY
40	X-CG outboard fittings, relative to inlet leading edge in PYLONS, in vehicle system in SUMARY, in.	PYLONS, SUMARY
41	Weight inboard pylon, per nacelle in PYLONS, per inboard nacelle set in SUMARY, 1b	PYLONS, SUMARY
42	X-CG inboard pylon, relative to inlet leading edge in PYLONS, in vehicle system in SUMARY, in.	PYLONS, SUMARY
43	Weight outboard pylon, per nacelle in PYLONS, per outboard nacelle set in SUMARY, 1b	PYLONS, SUMARY
44	X-CG outboard pylon, relative to inlet leading edge in PYLONS, in vehicle system in SUMARY, in.	PYLONS, SUMARY
45	Weight firewall, per nacelle in MISCOM, per inboard nacelle set in SUMARY, 1b	MISCOM, SUMARY
46	X-CG firewall, relative to inlet leading edge in MISCOM, in vehicle system in SUMARY, in.	MISCOM, SUMARY
47	Weight firewall in outboard nacelle set, 1b	SUMARY
48	X-CG outboard nacelle firewall, in.	SUMARY
49	Weight shroud, per nacelle in MISCOM, per inboard nacelle set in SUMARY, 1b	MISCOM, SUMARY
50	X-CG shroud, relative to inlet leading edge in MISCOM, in vehicle system in SUMARY, in.	MISCOM, SUMARY

TABLE 20. SUMM ARRAY VARIABLES (CONT)

Loc	Description	Subroutine Reference
51	Weight shroud in outboard nacelle set, 1b	SUMARY
52	X-CG outboard nacelle shroud, in.	SUMARY
53	Not used	
54	To	
55	Not used	
56	Weight inboard nacelle and engine section, 1b	SUMARY, AISMN
57	X-CG inboard nacelle and engine section, in.	SUMARY
58	Weight outboard nacelle and engine section, 1b	SUMARY, AISMN
59	X-CG outboard nacelle and engine section, in.	SUMARY
60	Weight nacelles and engine section, 1b	SUMARY
61	X-CG nacelles and engine section, in	SUMARY
62	Not used	
63	Not used	
64	Weight miscellaneous access doors, per nacelle in MISCOM, per vehicle in SUMARY, 1b	MISCOM, SUMARY
65	X-CG miscellaneous access doors, relative to inlet leading edge in MISCOM, in vehicle system in SUMARY, in.	MISCOM, SUMARY
66	Weight engine removal doors, per nacelle in MISCOM, per vehicle in SUMARY, 1b	MISCOM, SUMARY
67	X-CG engine removal doors, relative to inlet leading edge in MISCOM, in vehicle system in SUMARY, in.	MISCOM, SUMARY
68	Not used	
69	Not used	
70	Weight exterior finish, per nacelle in MISCOM, per vehicle in SUMARY, 1b	MISCOM, SUMARY
71	X-CG exterior finish, relative to inlet leading edge in MISCOM, in vehicle system in SUMARY, in.	MISCOM, SUMARY
72	Weight doors panels and miscellaneous, 1b	SUMARY, AISMN
73		

TABLE 20. SUMM ARRAY VARIABLES (CONCL)

Loc	Description	Subroutine Reference
74	X-CG doors panels and miscellaneous, in.	SUMARY
75	Weight engine section and nacelle group, 1b	SUMARY, AISMN
76	X-CG engine section and nacelle group, in.	SUMARY, AISMN
77	Not used	
200	Not used	
NOTE SUMM array starts at common location 1701.		

TABLE 21. TM ARRAY VARIABLES

Loc	Engrg Symbol	Description	Subroutine Reference
1		Temperature (design), °F	MATLF1,MCNTL1,MATLP2
2	$\mu$	Poisson's ratio	MATLF1,MCNTL1,MATLP2
3	$A_C$	Constant for compression stress-strain curve fit, in./in.	MATLF1,MCNTL1,MATLP2
4	$B_C$	Constant for compression stress-strain curve fit, in <sup>2</sup> ./lb	MATLF1,MCNTL1,MATLP2
5	$E_C$	Compression modulus of elasticity, psi	MATLF1,MCNTL1,MATLP2
6	$F_{CY}$	Compression yield stress, psi	MATLF1,MCNTL1,MATLP2
7	$A_T$	Constant for tension stress-strain curve fit, in./in.	MATLF1,MCNTL1,MATLP2
8	$B_T$	Constant for tension stress-strain curve fit, in. <sup>2</sup> /lb	MATLF1,MCNTL1,MATLP2
9	$E_T$	Tension modulus of elasticity, psi	MATLF1,MCNTL1,MATLP2
10	$F_{TY}$	Tension yield stress, psi	MATLF1,MCNTL1,MATLP2
11		Material density, lb/in. <sup>3</sup>	MATLF1,MCNTL1,MATLP2
12	$F_{TU}$	Ultimate tensile strength, psi	MATLF1,MCNTL1,MATLP2
13	$F_{CPL}$	Compressive stress at proportional limit, psi	MATLF1,MCNTL1,MATLP2
14	$E_{RT}$	Modulus of elasticity at room temperature, psi	MATLF1,MCNTL1,MATLP2
15	$G_{RT}$	Shear modulus at room temperature, psi	MATLF1,MCNTL1,MATLP2
16	$F_{SU}$	Ultimate shear strength, psi	MATLF1,MCNTL1,MATLP2
17	$F_{BRU}$	Ultimate bearing strength, psi	MATLF1,MCNTL1,MATLP2
18	$K_{FTU}$	Fraction of ultimate tensile strength at endurance limit for a polished specimen under cyclic load	MATLF1,MCNTL1,MATLP2

TABLE 21. TM ARRAY VARIABLES (CONT)

Loc	Engrg Symbol	Description	Subroutine Reference
19	$K_{FTU}$	Fraction of ultimate tension strength for shell-bending fatigue	MATLF1,MCNTL1,MATLP2
20	$K_{FTU}$	Fraction of ultimate tensile strength under cyclic pressure load	MATLF1,MCNTL1,MATLP2
21-30		Not used	
31	$\mu$	Poisson's ratio (interpolated)	MATLF1,MATLP2
32	$\epsilon_{C1}$	Compressive strain at point 1 (interpolated), in./in.	MATLF1,MATLP2
33	$\epsilon_{C5}$	Compressive strain at point 5 (interpolated), in./in.	MATLF1,MATLP2
34	$\sigma_{C1}$	Compressive stress at point 1 (interpolated), in./in.	MATLF1,MATLP2
35	$\sigma_{C2}$	Compressive stress at point 2 (interpolated), psi	MATLF1,MATLP2
36	$\sigma_{C3}$	Compressive stress at point 3 (interpolated), psi	MATLF1,MATLP2
37	$\sigma_{C4}$	Compressive stress at point 4 (interpolated), psi	MATLF1,MATLP2
38	$\sigma_{C5}$	Compressive stress at point 5 (interpolated), psi	MATLF1,MATLP2
39	$\epsilon_{T1}$	Tensile strain at point 1 (interpolated), in./in.	MATLF1,MATLP2
40	$\epsilon_{T5}$	Tensile strain at point 5 (interpolated), in./in.	MATLF1,MATLP2
41	$\sigma_{T1}$	Tensile stress at point 1 (interpolated), psi	MATLF1,MATLP2

TABLE 21. TM ARRAY VARIABLES (CONT)

Loc	Engrg Symbol	Description	Subroutine Reference
42	$\sigma_{T2}$	Tensile stress at point 2 (interpolated), psi	MATLF1,MATLP2
43	$\sigma_{T3}$	Tensile stress at point 3 (interpolated), psi	MATLF1,MATLP2
44	$\sigma_{T4}$	Tensile stress at point 4 (interpolated), psi	MATLF1,MATLP2
45	$\sigma_{T5}$	Tensile stress at point 5 (interpolated), psi	MATLF1,MATLP2
46	$F_{TU}$	Ultimate tensile strength (interpolated), psi	MATLF1
47	$F_{SU}$	Ultimate shear strength (interpolated), psi	MATLF1
48	$F_{BRU}$	Ultimate bearing strength (interpolated), psi	MATLF1
49		Not used	
50	$K_{FTU}$	Fraction of ultimate tensile strength at endurance limit (interpolated)	MATLF1
51	$K_{FTU}$	Fraction of ultimate tensile strength for shell-bending fatigue	MATLF1
52	$K_{FTU}$	Fraction of ultimate tensile strength under cyclic pressure load (interpolated)	MATLF1
53	$K_{FTU}$	Fatigue factor for wing (interpolated)	MATLF1
54	$K_{FTU}$	Fatigue factor for wing (interpolated)	MATLF1

TABLE 21. TM ARRAY VARIABLES (CONT)

Loc	Enrg Symbol	Description	Subroutine Reference
55		Temperature of material property data from library at temperature lower than design temperature, °F. Data in locations 56 through 79 are in same order as they appear in locations 31 through 54.	MATLF1
56	$\mu$		MATLF1
57	$\epsilon C1$		MATLF1
58	$\epsilon C5$		MATLF1
59	$\sigma C1$		MATLF1
60	$\sigma C2$		MATLF1
61	$\sigma C3$		MATLF1
62	$\sigma C4$		MATLF1
63	$\sigma C5$		MATLF1
64	$\epsilon T1$		MATLF1
65	$\epsilon T5$		MATLF1
66	$\sigma T1$		MATLF1
67	$\sigma T2$		MATLF1
68	$\sigma T3$		MATLF1
69	$\sigma T4$		MATLF1
70	$\sigma T5$		MATLF1
71	FTU		MATLF1
72	FSU		MATLF1
73	FBRU		MATLF1
74			
75	KFTU		MATLF1
76	KFTU		MATLF1
77	KFTU		MATLF1
78	KFTU		MATLF1
79	KFTU		MATLF1
80		Temperature of material property data from library at temperature higher than design temperature, °F. Data in locations 81	MATLF1

TABLE 21. TM ARRAY VARIABLES (CONT)

Loc	Engrg Symbol	Description	Subroutine Reference
80 cont		through 104 are in same order as they appear in locations 31 through 54.	
81	$\mu$		MATLF1
82	$\epsilon C1$		MATLF1
83	$\epsilon C5$		MATLF1
83	$\sigma C1$		MATLF1
85	$\sigma C2$		MATLF1
86	$\sigma C3$		MATLF1
87	$\sigma C4$		MATLF1
88	$\sigma C5$		MATLF1
89	$\epsilon T1$		MATLF1
90	$\epsilon T5$		MATLF1
91	$\sigma T1$		MATLF1
92	$\sigma T2$		MATLF1
93	$\sigma T3$		MATLF1
94	$\sigma T4$		MATLF1
95	$\sigma T5$		MATLF1
96	FTU		MATLF1
97	FSU		MATLF1
98	FBRU		MATLF1
99			
100	KFTU		MATLF1
101	KFTU		MATLF1
102	KFTU		MATLF1
103	KFTU		MATLF1
104	KFTU		MATLF1
105		Not used	
.			
.			
.			
109	Not used		
110	$A_{2,5}$	Curve fit constant for fit through points 2 and 5, in./in.	MATLF1
111	$A_{3,5}$	Curve fit constant for for through points 3 and 5, in./in.	MATLF1

TABLE 21. TM ARRAY VARIABLES (CONCL)

Loc	Enrg Symbol	Description	Subroutine Reference
112	$A_{4,5}$	Curve fit constant for fit through points 4 and 5, in./in.	MATLF1
113	$B_{2,5}$	Curve fit constant for fit through points 2 and 5, in. <sup>2</sup> /lb	MATLF1
114	$B_{3,5}$	Curve fit constant for fit through points 3 and 5, in. <sup>2</sup> /lb	MATLF1
115	$B_{4,5}$	Curve fit constant for fit through points 4 and 5, in. <sup>2</sup> /lb	MATLF1
116		Summation of errors squared for curve 2,5	MATLF1
117		Summation of errors squared for curve 3,5	MATLF1
118		Summation of errors squared for curve 4,5	MATLF1
119		Not used	
.			
.			
.			
160		Not used	
NOTE TM array starts at common location 3501. This array is used for interpolation of material data.			

TABLE 22. TMD ARRAY VARIABLES

Loc	Variable Name	Engrg Symbol	Description	Subroutine Description
1	MATLI		Material identification number	MCNTL1
2		$\rho$	Material density, lb/in. <sup>3</sup>	MCNTL1
3		$E_{RT}$	Modulus of elasticity at room temperature, psi	MCNTL1
4		$G_{RT}$	Shear modulus at room temperature, psi	MCNTL1
5		RA	Reduction area for fatigue	MCNTL1
6			Not used	
.				
.				
.				
109			Not used	
110			Temperature of material for data in locations 111 through 134, °F	MCNTL1,MATLF1
111		$\mu$	Poisson's ratio	MCNTL1,MATLF1
112		$\epsilon_{C1}$	Compressive strain at point 1, in./in.	MCNTL1,MATLF1
113		$\epsilon_{C5}$	Compressive strain at point 5, in./in.	MCNTL1,MATLF1
114		$\sigma_{C1}$	Compression stress at point 1, psi	MCNTL1,MATLF1
115		$\sigma_{C2}$	Compression stress at point 2, psi	MCNTL1,MATLF1
116		$\sigma_{C3}$	Compression stress at point 3, psi	MCNTL1,MATLF1
117		$\sigma_{C4}$	Compression stress at point 4, psi	MCNTL1,MATLF1
118		$\sigma_{C5}$	Compression stress at point 5, psi	MCNTL1,MATLF1
119		$\epsilon_{T1}$	Tensile strain at point 1, in./in.	MCNTL1,MATLF1
120		$\epsilon_{T5}$	Tensile strain at point 5, in./in.	MCNTL1,MATLF1
121		$\sigma_{T1}$	Tension stress at point 1, psi	MCNTL1,MATLF1
122		$\sigma_{T2}$	Tension stress at point 2, psi	MCNTL1,MATLF1

TABLE 22. TMD ARRAY VARIABLES (CONT)

Loc	Variable Name	Engrg Symbol	Description	Subroutine Description
123		$\sigma_{T3}$	Tension stress at point 3, psi	MCNTL1,MATLF1
124		$\sigma_{T4}$	Tension stress at point 4, psi	MCNTL1,MATLF1
125		$\sigma_{T5}$	Tension stress at point 5, psi	MCNTL1,MATLF1
126		$F_{TU}$	Ultimate tensile strength, psi	MCNTL1,MATLF1
127		$F_{SU}$	Ultimate shear strength, psi	MCNTL1,MATLF1
128		$F_{BRU}$	Ultimate bearing strength, psi	MCNTL1,MATLF1
129			Not used	
130		$K_{FTU}$	Fraction of ultimate tensile strength at endurance limit	MCNTL1,MATLF1
131		$K_{FTU}$	Fraction of ultimate tensile strength for shell-bending	MCNTL1,MATLF1
132		$K_{FTU}$	Fraction of ultimate tensile strength under cyclic pressure load	MCNTL1,MATLF1
133		$K_{FTU}$	Fatigue factor for wing	MCNTL1,MATLF1
134		$K_{FTU}$	Fatigue factor for wing	MCNTL1,MATLF1
135			Second temperature, °F, of material for data in locations 136 through 159	MCNTL1,MATLF1
136		$\mu$	Refer to description of location 111 through	MCNTL1,MATLF1
.				
.				
.				
159		$K_{FTU}$	description of location 134	MCNTL1,MATLF1
160			Third temperature, °F, of material for data in locations 161 through 184	MCNTL1,MATLF1
161		$\mu$	Refer to description of location 111 through	MCNTL1,MATLF1
.				
.				
.				
184		$K_{FTU}$	description of location 134	MCNTL1,MATLF1

TABLE 22. TMD ARRAY VARIABLES (CONCL)

Loc	Variable Name	Engrg Symbol	Description	Subroutine Description
185		$\mu$	Fourth temperature, °F, of material for data in locations 186 through 209	MCNTL1,MATLF1
186			Refer to description of location 111 through	MCNTL1,MATLF1
.				
.				
209		$K_{FTU}$	description of location 134	MCNTL1,MATLF1
210			Fifth temperature, °F, of material for data in locations 211 through 234	MCNTL1,MATLF1
211		$\mu$	Refer to description of location 111 through	MCNTL1,MATLF1
.				
.				
234		$K_{FTU}$	description of location 134	MCNTL1,MATLF
235			Sixth temperature, °F, of material for data in locations 236 through 259	MCNTL1,MATLF1
236		$\mu$	Refer to description of location 111 through	MCNTL1,MATLF1
.				
.				
259		$K_{FTU}$	description of location 134	MCNTL1,MATLF1
260			Not used	
.				
.				
284			Not used	
285	RM(1)		Alphanumeric material descriptive title	MCNTL1,MATLP2
.				
.				
300	RM(16)			MCNTL1,MATLP2
NOTE TMD array starts at common location 3201. This array is part of the permanent data file and is stored in mass storage file records 41 through 60.				

TABLE 23. TMS ARRAY VARIABLES

Loc	Engrg Symbol	Description	Subroutine Reference <sup>a</sup>
Locations 1 through 90 contain material properties data for the temperature associated with the maximum level-flight speed profile ( $M_H$ )			
1		Temperature of duct material, °F, locations 2 through 20 contain duct material data at this temperature	
2	$\mu$	Poisson's ratio	
3	$A_C$	Constant for compression stress-strain curve fit, in./in.	
4	$B_C$	Constant for compression stress-strain curve fit, in. <sup>2</sup> /lb	
5	$E_C$	Compression modulus of elasticity, psi	
6	$F_{CY}$	Compression yield stress, psi	
7	$A_T$	Constant for tension stress-strain curve fit, in./in.	
8	$B_T$	Constant for tension stress-strain curve fit, in. <sup>2</sup> /lb	
9	$E_T$	Tension modulus of elasticity, psi	
10	$F_{TY}$	Tension yield stress, psi	
11	$\rho$	Material density, lb/in. <sup>3</sup>	
12	$F_{TU}$	Ultimate tensile strength, psi	
13	$F_{CPL}$	Compressive stress at proportional limit, psi	
14	$E_{RT}$	Modulus of elasticity at room temperature, psi	

TABLE 23. TMS ARRAY VARIABLES (CONT)

Loc	Engrg Symbol	Description	Subroutine Reference <sup>a</sup>
15	G <sub>RT</sub>	Shear modulus at room temperature, psi	
16	F <sub>SU</sub>	Ultimate shear strength, psi	
17	F <sub>BRU</sub>	Ultimate bearing strength, psi	
18	K <sub>FTU</sub>	Fraction of ultimate tensile strength at endurance limit	
19	K <sub>FTU</sub>	Fraction of ultimate tensile strength for shell bending	
20	KFTU	Fraction of ultimate tensile strength under cyclic pressure load	
21		Not used	
.			
.			
.			
30		Not used	
31		Temperature of ramp material, °F, locations 32 through 50 contain ramp material data at this temperature	
32	μ		
33	A <sub>C</sub>		
34	B <sub>C</sub>		
35	E <sub>C</sub>		
36	F <sub>CY</sub>		PRECRT
37	A <sub>T</sub>		PRECRT
38	B <sub>T</sub>		
39	E <sub>T</sub>		
40	F <sub>TY</sub>		
41	ρ		
42	F <sub>TU</sub>		
43	F <sub>CPL</sub>		
44	E <sub>RT</sub>		
45	G <sub>RT</sub>		

TABLE 23. TMS ARRAY VARIABLES (CONT)

Loc	Engrg Symbol	Description	Subroutine Reference <sup>a</sup>
46	FSU	Not used	PRECRT
47	FBRU		
48	KFTU		
49	KFTU		
50	KFTU		
51			
.			
.			
.			
60			
61		Not used	
		Temperature of nacelle material, °F, locations 62 through 80 contain nacelle material data at this temperature	
62	μ		
63	AC		
64	BC		
65	EC		
66	FCY		
67	AT		
68	BT		
69	ET		
70	FTY		
71	ρ		
72	FTU		
73	FCPL		
74	ERT		
75	GRT		
76	FSU		
77	FBRU		
78	KFTU		
79	KFTU		
80	KFTU		
81		Not used	
.			
.			
.			
90		Not used	

TABLE 23. TMS ARRAY VARIABLES (CONT)

Loc	Engrg Symbol	Description	Subroutine Reference <sup>a</sup>
Locations 91 through 180 contain material properties data for the temperature associated with the limit speed profile ( $M_L$ ). Data are organized in the same sequence as noted for locations 1 through 90.			
91		Temperature of duct material, °F, locations 92 through 110 contain duct material data at this temperature	
92	$\mu$		
93	AC		
94	BC		
95	EC		
96	FCY		
97	AT		
98	BT		
99	ET		
100	FTY		
101	P		
102	FTU		
103	FCPL		
104	ERT		
105	GRT		
106	FSU		
107	FBRU		
108	KFTU		
109	KFTU		
110	KFTU		
111		Not used	
.			
.			
.			
120		Not used	
121		Temperature of ramp material, °F, locations 122 through 140 contain ramp material data at this temperature	

TABLE 23. TMS ARRAY VARIABLES (CONT)

Loc	Engrg Symbol	Description	Subroutine Reference <sup>a</sup>
122	$\mu$		
123	A <sub>C</sub>		
124	E <sub>C</sub>		
125	B <sub>C</sub>		
126	F <sub>CY</sub>		PRECRT
127	A <sub>T</sub>		
128	B <sub>T</sub>		
129	E <sub>T</sub>		
130	F <sub>TY</sub>		
131	$\rho$		PRECRT
132	F <sub>TU</sub>		
133	F <sub>CPL</sub>		
134	E <sub>RT</sub>		
135	G <sub>RT</sub>		
136	F <sub>SU</sub>		PRECRT
137	F <sub>BRU</sub>		
138	K <sub>FTU</sub>		
139	K <sub>FTU</sub>		
140	K <sub>FTU</sub>		
141		Not used	
.			
.			
150		Not used	
151		Temperature of nacelle material, °F, locations 152 through 170 contain nacelle material data at this temperature	
152	$\mu$		
153	A <sub>C</sub>		
154	B <sub>C</sub>		
155	E <sub>C</sub>		
156	F <sub>CY</sub>		PYLONS
157	A <sub>T</sub>		
158	B <sub>T</sub>		
159	E <sub>T</sub>		NACELE
160	F <sub>TY</sub>		
161	$\rho$		NACELE, PYLONS
162	F <sub>TU</sub>		PYLONS

TABLE 23. TMS ARRAY VARIABLES (CONCL)

Loc	Engrg Symbol	Description	Subroutine Reference <sup>a</sup>
163	FCPL	Not used	PYLONS PYLONS
164	ERT		
165	GRT		
166	FSU		
167	FBRU		
168	KFTU		
169	KFTU		
170	KFTU		
171			
.			
.			
.			
180		Not used	
NOTE TMS array starts at common location 3691. This array is calculated for each speed profile altitude and stored in mass storage file records 109 through 117.			
<sup>a</sup> This array is defined and written by MCNTL1 and read by PRECRT, NACELE, and PYLONS. Using routines are referenced only when specific variables in this array are used.			

TABLE 24. TOT ARRAY VARIABLES

Loc	Variable Name	Description	Subroutine Reference
1	TOTAL	Weight per inch of duct length of duct panels and frames at duct cut for initial frame spacing, lb/in.	DUCTS
2		Weight per inch of duct length of duct panels and frames at duct cut for subsequent frame spacing, lb/in.	DUCTS
3		Duct weight per inch of duct length at synthesis cut, lb/in.	DUCPNL, DUCTS
4		Duct frame weight per inch of duct length at duct cut, lb/in.	DUCFRM, DUCTS
5		Not used	
10		To	
11		Not used	
12		Duct surface area per nacelle, in. <sup>2</sup>	DUCTS
13		Nacelle surface area per nacelle, in. <sup>2</sup>	NACELE, MISCOM
19		Not used	
20		To	
21		Not used	
22		Two-dimensional variable-geometry ramp structure weight per inlet in RAMPS, weight per nacelle in AISMN, lb	RAMPS, AISMN, SUMMARY
23		Duct weight per nacelle, lb	DUCTS, PYLONS
24		Weight longitudinal members per nacelle, lb	NACELE, PYLONS
25		Weight inlet lip per nacelle, lb	DUCWET, DUCTS, PYLONS
26		Weight ramp 1 panel per inlet in RAMPS, weight per nacelle in AISMN, lb	RAMPS, AISMN, PYLONS, SUMMARY
		Weight ramp 1 transverse beams per inlet in RAMPS, weight per nacelle in AISMN, lb	RAMPS, AISMN, PYLONS, SUMMARY
		Weight ramp 2 panel per inlet in RAMPS, weight per nacelle in AISMN, lb	RAMPS, AISMN, PYLONS, SUMMARY

TABLE 24. TOT ARRAY VARIABLES (CONT)

Loc	Variable Name	Description	Subroutine Reference
27	R2TRAN	Weight ramp 2 transverse beams per inlet in RAMPS, weight per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
28	R3LONG	Weight ramp 3 panel per inlet in RAMPS, weight per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
29	FHINGE	Weight forward ramp hinge beam per inlet in RAMPS, weight per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
30	FACT	Weight forward ramp actuator beam per inlet in RAMPS, weight per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
31	AACT, ACT	Weight aft ramp actuator beam per inlet in RAMPS, weight per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
32	AHINGE	Weight aft ramp hinge beam per inlet in RAMPS, per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
33	R4LONG	Weight ramp 4 panel per inlet in RAMPS, per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
34	R4TRAN	Weight ramp 4 transverse beams per inlet in RAMPS, per nacelle in AISMN, 1b	RAMPS,AISMN, PYLONS,SUMARY
35	WHFS	Weight fixed spike per nacelle, 1b	SPIKE,PYLONS
36	WFTS	Weight translating spike per nacelle, 1b	SPIKE,PYLONS
37	WTES	Weight translating and expanding spike per nacelle, 1b	SPIKE,PYLONS
38		Weight nacelle covers per nacelle, 1b	NACELE,PYLONS
39		Weight nacelle frames per nacelle, 1b	NACELE,PYLONS
40	WTEM	Weight engine mounts per nacelle, 1b	MISCOM,PYLONS
41	WTAI	Weight auxiliary inlets per nacelle, 1b	MISCOM,PYLONS
42	WTBP	Weight duct bypass doors per nacelle, 1b	MISCOM,PYLONS

TABLE 24. TOT ARRAY VARIABLES (CONCL)

Loc	Variable Name	Description	Subroutine Reference
43	WTED	Weight engine removal doors per nacelle, 1b	MISCOM,PYLONS
44	WTMD	Weight miscellaneous doors per nacelle, 1b	MISCOM,PYLONS
45	WTFW	Weight firewall per nacelle, 1b	MISCOM,PYLONS
46	WTSD	Weight shroud per nacelle, 1b	MISCOM,PYLONS
47	WTEF	Weight exterior finish per nacelle, 1b	MISCOM,PYLONS
48		Not used	
.		To	
50		Not used	
51	WTPI	Weight inboard pylon per nacelle, 1b	PYLONS
52	WTPO	Weight outboard pylon per nacelle, 1b	PYLONS
53	WFTI	Weight inboard fittings per nacelle, 1b	PYLONS
54	WFTO	Weight outboard fittings per nacelle, 1b	PYLONS
55		Not used	
.		To	
100		Not used	
NOTE TOT array starts at common location 2101.			

TABLE 25. TT ARRAY VARIABLES

Loc	Engrg Symbol	Description	Subroutine Reference
1	A	Material identification number	MCNTL1,MATLF1
2		Material temperature, °F	MCNTL1,MATLF1
3		Constant for stress-strain curve fit and interpolation factor, in./in.	MATLF1
4	B	Constant for stress-strain curve fit, in. <sup>2</sup> /lb	MATLF1
5	$E = \sigma_1 / \epsilon_1$	Modulus of elasticity, psi	MATLF1
6	$\epsilon_1$	Strain at point 1 (proportional limit), in./in.	MATLF1
7	$\epsilon_2$	Strain at point 2, in./in.	MATLF1
8	$\epsilon_3$	Strain at point 3, in./in.	MATLF1
9	$\epsilon_4$	Strain at point 4, in./in.	MATLF1
10	$\epsilon_5$	Strain at point 5 (yield stress), in./in.	MATLF1
11	$\sigma_1$	Stress at point 1 (proportional limit), psi	MATLF1
12	$\sigma_2$	Stress at point 2, psi	MATLF1
13	$\sigma_3$	Stress at point 3, psi	MATLF1
14	$\sigma_4$	Stress at point 4, psi	MATLF1
15	$\sigma_5$	Stress at point 5 (yield stress), psi	MATLF1
16	1/E	Reciprocal of modulus of elasticity, in. <sup>2</sup> /lb	MATLF1

TABLE 25. TT ARRAY VARIABLES (CONCL)

Loc	Enrg Symbol	Description	Subroutine Reference
17	$\epsilon_5 - \sigma_5/E$	Strain increment at yield stress, in./in.	MATLF1
18	$\epsilon_2 - \sigma_2/E,$ $\epsilon_3 - \sigma_3/E,$ $\epsilon_4 - \sigma_4/E$	Strain increment at other points, in./in.	MATLF1
19	$\sigma_5 - \sigma_2,$ $\sigma_5 - \sigma_3,$ $\sigma_5 - \sigma_4$	Stress increments, psi	MATLF1
20	$(d\sigma_1/d\epsilon_1) =$ $1/(1/E +$ $A B e^{B\sigma_1})$	Curve fit calculation of modulus of elasticity at proportional limit, psi	MATLF1
21	$1 - (d\sigma_1/d\epsilon_1)/E$	Error in calculated value of modulus of elasticity	MATLF1
22	$\sigma_n/E +$ $A e^{B\sigma_n};$ $n = 1,5$	Calculated strain at points 1 through 5	MATLF1
23		Error in calculated value of strains	MATLF1
24		Summation of errors squared which produce best curve fit	MATLF1
25		Material temperature, °F	MCNTL1
NOTE TT array starts at common location 3661. This array is used for tension and compression stress-strain curve fit.			

TABLE 26. FDAT ARRAY VARIABLES (FDATT BLOCK)

Loc	Description	Subroutine Reference
1	Locations 1 through 50 are used to	
.	store wing, empennage, fuselage, and	
50	landing gear weight data	
51	Air induction system structure weight, lb	ISMN
52	X-CG air induction system structure, in.	ISMN
53	Inboard nacelle and engine section weight, lb	ISMN
54	Outboard nacelle and engine section weight, lb	ISMN
55	Engine section doors, panels, and miscellaneous structure weight, lb	ISMN
56	Total engine section and nacelles weight, lb	ISMN
57	X-CG engine section and nacelles, in.	ISMN
58	Not used	
59	Not used	
60	Not used	

TABLE 27. IP ARRAY VARIABLES (IPRINT BLOCK)

Loc	Description	Figure Reference	Subroutine Reference
1 . 60	Locations 1 through 60 are print controls for other program modules		
61	Output print control of air induction system input design data	23	AISFN
62	Output print control of vehicle speed-altitude profile data	24	SPAL
63	Output print control of duct, ramp, and nacelle material properties (refer to Table 21)	25,26,27	MCNTL1 (MATLP2)
64	Output print control of calculated material properties data (refer to Table 23)	28	MCNTL1
65	Output print control of inlet duct design pressure data	29	DSGNP
66	Output print control of ramp design criteria	30	PRECRT
67	Output print control of ramp design constants, reaction forces, and detail weights	31	RAMPS
68	Output print control of duct frame redundants and geometry data	34	FRMELD
69	Output print control of duct frame sizing and unit internal loads data, duct geometry and sizing, and summary weight data	32,33	DUCTS
70	Output print control of nacelle geometry, sizing, and weight summary data	35	NACELE
71 . 80	Locations 71 through 80 are print controls for the fuselage module		

TABLE 28. MASS STORAGE FILE RECORDS

Record No.	Variables & Length	Write Routine	Read Routine	Description
28	D(2000)	Input data processing module	AI SMN	Input air induction system, nacelle, and engine section design data; refer to first 2,000 locations in Table 9 (locations 1701-1900 are used for calculated variables, SUMM array)
41-60	TMD(300)	Input data processing module	MCNTL1	Permanent file material properties library data; refer to Table 22 for discussion of variables
109-117	TMS(180)	MCNTL1	PRECRT NACELE PYLONS	Duct, ramp, and nacelle material property data at each of 9 flight profile points; refer to Table 23 for discussion of variables

## SUBROUTINE DESCRIPTIONS

### PROGRAM AISMN

#### General Description

Deck name: AISMN  
Entry name: OVERLAY (5HALPHA, 7,0)  
Called by: OLAY00  
Subroutines called: SPAL, MCNTL1, DSGNP, PRECRT, RAMPS, SPIKE, DUCTS, NACELE, MISCOM, PYLONS, SUMARY

This is the control routine for the air induction system weight estimation module. This routine initializes the blank common region and reads the input data from mass storage file record 28. Certain design variables from the input data set are printed by this routine (Figure 23).

Appropriate analysis routines are called, and the resultant weight and balance summaries are stored in the labeled common array, FDAT. This routine is designed to control the evaluation of air induction system, nacelle, and engine section structure or only two-dimensional variable-geometry ramps.

#### Arrays and Variables Used

DATK Weight correlation factors (refer to EQU array, Table 17)  
DATR Ramp geometry and design data (refer to Table 15)  
DATS Air induction system, nacelle, and engine section data (refer to Table 16)  
IP Print control (refer to "Labeled Common Arrays")  
SUMM Weight summary data (refer to Table 20)  
TOT Weight summary data (refer to Table 24)  
XMISC Refer to "Labeled Common Arrays"

#### Arrays and Variables Calculated

FDAT Weight summary data (refer to "Labeled Common Arrays")  
ITP Number of nacelles  
IVG Inlet type inductor

- 1 = fixed duct
- 2 = fixed spike
- 3 = horizontal ramp
- 4 = vertical ramp
- 5 = translating spike
- 6 = translating and expanding spike

### VAP I-SWEEP WING CONFIGURATION

## AIR INDUCTION SYSTEM DATA

NUMBER OF NACELLES		2.0
BYPASS RATIO		0.0
(1.=FIXED DUCT	2.=FIXED SPIKE)	
(3.=HORIZ. RAMP	4.=VERT. RAMP)	4.0
(5.=TRANSL.SPIKE	6.=EXPND.SPIKE)	
CAPTURE AREA PER INLET		11202.00
NUMBER OF INLETS PER AIR VEHICLE		2.0
X DISTANCE OF THROAT FROM L.E. OF COML OR LIP		320.000
NUMBER OF ENGINES		4.0
THRUST PER ENGINE		78240.00
HEIGHT PER ENGINE		21052.500
LENGTH OF ENGINE		290.000
DIAMETER OF ENGINE		99.000
ENGINE C.G., DISTANCE AFT OF FACE		102.000
X AT COML OR LIP, SET 1		1960.000
Y AT ENGINE FACE, SET 1		85.000
Z AT ENGINE FACE, SET 1		340.000
X AT COML OR LIP, SET 2		0.0
Y AT ENGINE FACE, SET 2		0.0
Z AT ENGINE FACE, SET 2		0.0
AVERAGE SWEEP OF PYLON		0.0
MOUNTING TYPE (0.=VERT, 1.=HORIZ) IB-PYLON		0.0
AVERAGE CHORD OF INBOARD PYLON		0.0
SPAN OF INBOARD PYLON		0.0
AVERAGE CHORD OF OUTBOARD PYLON		0.0
SPAN OF OUTBOARD PYLON		0.0
PYLON THICKNESS TO CHORD RATIO		0.0
AUXILIARY INLET AREA PER NACELLE OR AIR VEHICLE		0.0
DUCT BYPASS AREA PER NACELLE OR AIR VEHICLE		0.0
AREA OF MISCELLANEOUS DOORS		0.0
SHROUD INDICATOR (0.=NO, 1.=YES=CALC.GT 1.=SHROUD APFA)		1.000
MATERIAL NUMBER FOR DUCTS		13.0
MATERIAL NUMBER FOR RAMPS		13.0
MATERIAL NUMBER FOR NACELLES		13.0
PRINT CHOICE (1.=MIN., 2.=ADD SPD.PRF., ... 4.=MAX.)		0.0
PITCHING LOAD FACTOR		2.000
VERTICAL LOAD FACTOR		2.50
FACTORS...DUCTS=		1.00
FRAMES=		1.00
COVERS=		1.00
LONGERONS=		1.00

Figure 23. Sample output from AISN of air induction system design data (IP(61)).

MMATL Number of arrays of material properties in mass storage file,  
records 41 through 60  
T(1) Number of inlets per nacelle  
TOT Weight summary data (refer to Table 24)

#### Labeled Common Arrays

FDAT Weight summary data (refer to Table 26)  
IP(61) Print/no print indicator  
  
0 = print input design data (Figure 23)  
1 = do not print  
  
XMISC(1) Number of arrays of material properties in mass  
storage file, records 41 through 60  
XMISC(85) Alphanumeric case title  
XMISC(100)

#### Mass Storage File Records

Read by routine:

Record 28

Written by routine:

None

#### Error Messages

None

#### SUBROUTINE SPAL

#### General Description

Deck name: SPAL  
Entry name: SPAL  
Called by: AISN  
Subroutines called: TEMPR

This subroutine expands the input speed-altitude profile data by interpolating between the input points. Profiles examined are level-flight maximum speed,  $M_H$ , and limit speed,  $M_L$ , envelopes with the wing fixed or in the aft position.

Limit speed at the input points is determined from the input  $M_H$  points and  $M_H$ - $M_L$  relationship. This relationship is either given for each of the input points or specified as a general relationship, as shown in the following:

<u>Input <math>M_H</math>-<math>M_L</math> Relationship</u>	<u>Description</u>
0.0	$M_L$ equal to $M_H$
>0.0; <1.0	Decimal to be added to $M_H$
>1.0	Multiplier of $M_H$
<0.0	Fraction of $M_H$ to be added to $M_H$

$M_H$  and  $M_L$  data are input of five altitudes. Intermediate altitudes are obtained by taking points midway between the input altitudes, thus defining nine altitudes. Subroutine TEMPR is called to calculate atmospheric properties at each of these altitudes. Dynamic pressure is then calculated for the input points. Dynamic pressure at the interpolated altitudes is obtained by interpolating between dynamic pressure at the input points, and speed is determined for the dynamic pressure and altitude.

Pressure recovery ratio and airflow at the engine is either input or calculated for the initial five points. Values at the four additional points are obtained by interpolation.

Having determined mach number, pressure recovery ratio, and airflow at the engine for the nine profile points, total temperature, total pressure, and static pressure are then calculated.

#### Arrays and Variables Used

D	Constants (refer to Table 11)
DATM	Speed-altitude profile data (refer to Table 13)
DVLG	General relationship between limit speed and level flight maximum speed (DATM)
EQU	Equation and physical constants (refer to Table 17)
IP	Print control (refer to "Labeled Common Arrays")
PRESH	S(2), ambient pressure at altitude, psf
RATC	General pressure recovery ratio (DATM)
TEMALT	S(1), ambient temperature at altitude, °R
XMISC	Refer to "Labeled Common Arrays"

#### Arrays and Variables Calculated

ALT	Nine altitudes on speed profile, ft
CS	Speed of sound at nine speed profile altitudes, ft/sec

EMH	Airflow at engine on $M_H$ diagram, M
EML	Airflow at engine on $M_L$ diagram, M
G	Acceleration of gravity at nine speed profile altitudes, $\text{ft/sec}^2$
PO	Ambient pressure at nine speed profile altitudes, psf
PSH	Static absolute pressure at engine on $M_H$ diagram, psia
PSL	Static absolute pressure at engine on $M_L$ diagram, psia
PTH	Total pressure at engine on $M_H$ diagram, psia
PTL	Total pressure at engine on $M_L$ diagram, psia
QH	Dynamic pressure on $M_H$ diagram, psf
QL	Dynamic pressure on $M_L$ diagram, psf
RATH	Inlet pressure recovery ratio on $M_H$ diagram
RATL	Inlet pressure recovery ratio on $M_L$ diagram
RHO	Density of air at nine speed profile altitudes, $\text{lb/ft}^3$
TEM	Ambient temperature at nine speed profile altitudes, $^{\circ}\text{R}$
TEMH	Total temperature on $M_H$ diagram, $^{\circ}\text{R}$
TEML	Total temperature on $M_L$ diagram, $^{\circ}\text{R}$
VH	Level-flight maximum speed, $M_H$ , at nine speed profile altitudes, M
VL	Limit speed, $M_L$ at nine speed profile altitudes, M

#### Labeled Common Arrays

IP(62)      Print/no print indicator

0 = print speed-altitude profile data (see Figure 24)  
1 = do not print

XMISC(85) Case title

to

XMISC(100)

#### Mass Storage File Records

None

#### Error Messages

None

\*\* SPAL -

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VAP1-SWEEP WING CONFIGURATION

\*\*\* SPEED ALTITUDE PROFILE TABLES \*\*\*

STANDARD ATMOSPHERE

ALTITUDE FEET	TEMPERATURE DEG RANKINE	DENSITY PCF	PRESSURE PSF	G FT/SFC SO	SPEED OF SOUND FT/SEC
0.0	519.670	0.0765455	2116.22	32.174	1115.90
14500.0	466.960	0.0489584	1218.52	32.130	1058.09
20000.0	415.251	0.0297103	657.57	32.086	997.10
37500.0	382.970	0.0212501	441.60	32.060	965.88
46000.0	380.970	0.0141232	293.56	32.034	965.49
53000.0	382.970	0.0100882	209.60	32.013	965.17
60000.0	389.970	0.0072060	149.78	31.992	964.85
65000.0	389.970	0.0056466	117.78	31.976	964.62
70000.0	392.375	0.0044318	92.68	31.961	967.36

PROFILE TABLE

ALT. FEET	V(M) MN	O(M) PSE	M2 MN	PT2/PT0 MN	RAM T NEG P	PT2 PSI	P2 PSI	V(L) MN	O(L) PSE	M2 MN	PT2/PT0 MN	RAM T NEG R	PT2 PSI	P2 PSI
0.0	0.53	416.11	0.50	1.0000	547.91	17.79	15.00	0.64	599.20	0.50	1.0000	560.63	19.30	16.27
14500.0	0.70	415.77	0.50	1.0000	512.48	11.72	9.88	0.84	599.70	0.40	1.0000	532.51	13.40	12.00
20000.0	0.85	415.42	0.50	1.0000	490.20	8.16	6.88	1.14	599.21	0.30	0.9947	523.18	10.20	9.58
37500.0	1.39	500.42	0.40	0.5796	539.01	9.32	8.35	1.61	805.24	0.30	0.9612	593.10	12.79	12.02
46000.0	1.93	765.42	0.30	0.9320	680.49	13.34	12.53	2.22	1012.27	0.30	0.9020	774.18	20.27	19.04
53000.0	2.28	764.98	0.30	0.8950	766.40	15.86	14.90	2.63	1011.55	0.30	0.8555	927.47	25.85	24.28
60000.0	2.70	764.33	0.30	0.8465	958.54	20.50	19.26	3.10	1010.82	0.30	0.7951	1141.91	35.53	33.38
65000.0	2.70	601.95	0.30	0.8465	958.54	16.12	15.14	3.08	781.25	0.30	0.7987	1129.01	26.07	25.34
70000.0	2.70	472.07	0.30	0.8465	964.46	13.69	11.92	2.92	551.67	0.30	0.8196	1059.65	17.07	16.04

Figure 24. Sample output from SPAL of speed-altitude profile data (IP(62)).

## SUBROUTINE TEMPR

### General Description

Deck name: TEMPR  
Entry name: TEMPR  
Called by: SPAL  
Subroutines called: None

This subroutine calculates standard atmosphere temperature and pressure by using equation representations which are functions of geopotential altitude. Altitude at which pressure and temperature are to be calculated is determined by the counter, I, which is defined by the calling routine.

### Arrays and Variables Used

ALT Nine altitudes on speed profile, ft  
D Constants (refer to Table 11)  
EQU Equation and physical constants (refer to Table 17)  
I Index for speed profile altitude point

### Arrays and Variables Calculated

ALOFT S(3), altitude divided by 1,000, ft/1,000  
PRESH S(2), ambient pressure at ALT (I), °R  
TEMALT S(1), ambient temperature at ALT (I), °R

### Labeled Common Arrays

None

### Mass Storage File Records

None

### Error Messages

● \*\*\* WARNING MESSAGE \*\*\*  
ALTITUDE IS BEYOND VALID RANGE OF PRESSURE

● \*\*\* WARNING MESSAGE \*\*\*

ALTITUDE IS BEYOND VALID RANGE OF TEMPERATURE

These messages are printed for altitude greater than 154,199.48 feet. The pressure and temperature are calculated by the equation for the highest altitude range.

SUBROUTINE MCNTL1

General Description

Deck name: MCNTL1  
Entry name: MCNTL1  
Called by: AISMN  
Subroutines called: MATLF1, MATLP2

This subroutine controls development of material property data for the duct, two-dimensional variable-geometry ramps, and nacelles. Material properties for these components are calculated at each of the nine speed profile altitudes for temperatures associated with level-flight maximum speed and limit speed. This routine reads the material properties library data from mass storage file records 41 through 60, calls subroutine MATLF1 to calculate the material properties at the temperature, and stores this data on mass storage file records 109 through 117. Records 109 through 117 correspond to the nine speed profile altitudes. Certain duct structure material properties are also stored in blank common.

Ducts are assumed to exist on all flight vehicles. Material properties for ramp and nacelle structures are only calculated when they exist.

Arrays and Variables Used

DATS(1) Number of nacelles  
DATS(31) Duct structural material identification number  
DATS(32) Variable-geometry ramps structural material identification number  
DATS(33) Nacelle structural material identification number  
EQU(28) Conversion ° R to ° F,  $460^{\circ} R$   
IP Print control (refer to "Labeled Common Arrays")  
IVG Inlet type indicator

1 = fixed duct  
2 = fixed spike  
3 = horizontal ramp

- 4 = vertical ramp
- 5 = translating spike
- 6 = translating and expanding spike

NMATL	Number of arrays of material properties in mass storage file records 41 through 60
TEMH	Total temperature on $M_H$ diagram, °R
TEML	Total temperature on $M_L$ diagram, °R
TM	Calculated material data (refer to Table 21)
TMD	Material properties file record data (refer to Table 22)

### Arrays and Variables Calculated

EH	Duct material modulus of elasticity on $M_H$ diagram, psi
EL	Duct material modulus of elasticity on $M_L$ diagram, psi
FCYH	Duct material compression yield stress on $M_H$ diagram, psi
FCYL	Duct material compression yield stress on $M_L$ diagram, psi
FKTH	Duct material tensile strength under cyclic loading on $M_H$ diagram, fraction of ultimate tensile strength
FKTL	Duct material tensile strength under cyclic loading on $M_L$ diagram, fraction of ultimate tensile strength
FMUH	Duct material Poisson's ratio on $M_H$ diagram
FMUL	Duct material Poisson's ratio on $M_L$ diagram
FSUH	Duct material ultimate shear strength on $M_H$ diagram, psi
FSUL	Duct material ultimate shear strength on $M_L$ diagram, psi
FTUH	Duct material ultimate tensile strength on $M_H$ diagram, psi
FTUL	Duct material ultimate tensile strength on $M_L$ diagram, psi
IF3	Material properties library file record number
IF4	Calculated material properties file record number
II	Counter through nine speed profile points
JJ	Counter for $M_H$ and $M_L$ at each speed profile altitude
KK	Structural component counter

- 1 = duct
- 2 = ramps
- 3 = nacelles

MATLI	Material identification number
RHOD	Duct material density, lb/in. <sup>3</sup>
TMS	Calculated material properties (refer to Table 23)
TT(1)	Material identification number
TT(2)	Material temperature, °F
TT(25)	Material temperature, °F

### Labeled Common Arrays

IP(63) Print/no print indicator

- 0 = print material properties of structural components for first profile point by calling MATLP2 (see Figures 25, 26, and 27)
- 1 = do not print

IP(64) Print/no print indicator

- 0 = print material properties in TMS array (see Figure 28)
- 1 = do not print

### Mass Storage File Records

Read by routine:

Records 41 through 60

Written by routine:

Records 109 through 117

### Error Messages

- MATL INPUT ERROR. ASSUMED MATL NO. 1 III XXX YYY

The foregoing message appears when the input material number is not within the limits of the material library. The total number of materials on file (III), the material number requested (XXX), and the design temperature (YYY) appear below the printed message. If the program assumption is unacceptable, the input data should be corrected.

- MATL TEMPERATURE ERROR MATL NO. XXX.X REQD YYY.Y DEG. ASSUMED TEMP = ZZZ.Z DEG

The foregoing message appears when the design temperature (YYY.Y) is less than or equal to zero. The program assumes the lowest temperature on file (ZZZ.Z) and proceeds. If the design temperature is as indicated, and the material properties at that temperature are required, the material library data should be changed to include properties at the design temperature.

```

POINT 1
--DUCT MATERIAL DATA. MATL NO. 13--
6AL-4V TI-A9 SMT/PLATE TO .250 IN. REF-TF1.90/1.10 2-22-69
120 WRS AT 200 DEG. MIL-WDRK-5 A DATA

TEMP.= P7.91 DENSITY= 0.1600 MU= 0.3304

COMPRESSION
TENSION
0.16166793E-12 0.16943787E-03 16361837.0 16400220.0 6165500.0
0.16166793E-12 0.16943787E-03 16361837.0

COMPRESSION
TENSION
EPS(P) EPS(V) F(P) F(V) F(2) F(3) F(4) F(V)
0.007209 0.010383 117958.9 125997.9 131121.6 134634.6 137154.1
0.007209 0.010383 117958.9 125997.9 131121.6 134634.6 137154.1

FTU= 138154.1 FSU= 80577.1 FBRU= 250000.0

TM
1 0.07808105E+02 0.33039033E+00 0.16166793E-12 0.16943787E-03 0.16361837E+08
6 0.13715412E+06 0.16166793E-12 0.16943787E-03 0.16361837E+06 0.13715412E+06
11 0.16000003E+00 0.13815412E+06 0.11795887E+06 0.16400220E+08 0.61655000E+07
16 0.80577062E+05 0.25000000E+06 0.17828774E+00 0.69999999E+00 0.20924962E+00
21 0.0 0.0 0.0 0.0 0.0
26 0.0 0.0 0.0 0.0 0.0

TMD
10 0.0 0.0 0.0 0.0 0.0 0.0 0.0
20 0.0 0.0 0.0 0.0 0.0 0.0 0.0

```

Figure 25. Sample output from MATLP2 of duct material properties data (IP(63)).

```

PRINT 1
--RAMP MATERIAL DATA. MATL NO. 13--
6AL-4V YI-A* SMT/PLATE IN .250 IN. REF-TF1.90/1.10 2-22-60
120 HRS AT 200 DEG. MIL-HDBK-5 R DATA

TFMO.= 87.81 DENSITY= 0.1600 MU= 0.3304

COMPRESSION
TENSION
1 0.16166793E-12 0.16043787E-03 16361937.0 16400220.0 164634.6 137154.1
0.16166793E-12 0.16043787E-03 16361837.0 16400220.0 164634.6 137154.1

COMPRESSION
TENSION
FPS(P) FPS(V) F(P) F(V) F(1) F(2) F(3) F(4) F(V)
0.007200 0.010383 117058.9 125997.9 131121.6 131121.6 134634.6 137154.1
0.007200 0.010383 117558.9 125997.9 131121.6 131121.6 134634.6 137154.1

FTU= 138154.1 FSU= 80577.1 FRAU= 250000.0

TW 1 0.87809105E+02 0.13039023E+00 0.16166793E-12 0.16043787E-03 0.16361837E+00
6 0.13715412E+06 0.16166793E-12 0.16043787E-03 0.16361837E+00 0.13715412E+06
11 0.16000003E+00 0.13815412E+06 0.11795887E+06 0.16400220E+00 0.61655000E+07
16 0.80577062E+05 0.25000000E+06 0.17928774E+00 0.69999999E+00 0.20924968E+00
21 0.0 0.0 0.0 0.0 0.0
26 0.0 0.0 0.0 0.0 0.0

TMD 10 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0
20 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

```

Figure 26. Sample output from MATLP2 of ramp material properties data (IP(63)).



```

** MCNTL1 - IP(64)

TMS REGION PROFILE PRINT = 1

1 0.67524105E+02 0.33035033E+00 0.16166793E-12 0.16943797E-03 0.16361837E+08
2 0.13715412E+06 0.16166793E-12 0.16943797E-03 0.16943797E-03 0.13715412E+06
3 0.16000000E+00 0.13715412E+06 0.16166793E-12 0.16943797E-03 0.16361837E+08
4 0.90577062E+05 0.25000000E+06 0.13715412E+06 0.16943797E-03 0.16361837E+08
5 0.0 0.0 0.0 0.0 0.0
6 0.0 0.0 0.0 0.0 0.0
7 0.0 0.0 0.0 0.0 0.0
8 0.0 0.0 0.0 0.0 0.0
9 0.0 0.0 0.0 0.0 0.0
10 0.0 0.0 0.0 0.0 0.0
11 0.0 0.0 0.0 0.0 0.0
12 0.0 0.0 0.0 0.0 0.0
13 0.0 0.0 0.0 0.0 0.0
14 0.0 0.0 0.0 0.0 0.0
15 0.0 0.0 0.0 0.0 0.0
16 0.0 0.0 0.0 0.0 0.0
17 0.0 0.0 0.0 0.0 0.0
18 0.0 0.0 0.0 0.0 0.0
19 0.0 0.0 0.0 0.0 0.0
20 0.0 0.0 0.0 0.0 0.0
21 0.0 0.0 0.0 0.0 0.0
22 0.0 0.0 0.0 0.0 0.0
23 0.0 0.0 0.0 0.0 0.0
24 0.0 0.0 0.0 0.0 0.0
25 0.0 0.0 0.0 0.0 0.0
26 0.0 0.0 0.0 0.0 0.0
27 0.0 0.0 0.0 0.0 0.0
28 0.0 0.0 0.0 0.0 0.0
29 0.0 0.0 0.0 0.0 0.0
30 0.0 0.0 0.0 0.0 0.0
31 0.0 0.0 0.0 0.0 0.0
32 0.0 0.0 0.0 0.0 0.0
33 0.0 0.0 0.0 0.0 0.0
34 0.0 0.0 0.0 0.0 0.0
35 0.0 0.0 0.0 0.0 0.0
36 0.0 0.0 0.0 0.0 0.0
37 0.0 0.0 0.0 0.0 0.0
38 0.0 0.0 0.0 0.0 0.0
39 0.0 0.0 0.0 0.0 0.0
40 0.0 0.0 0.0 0.0 0.0
41 0.0 0.0 0.0 0.0 0.0
42 0.0 0.0 0.0 0.0 0.0
43 0.0 0.0 0.0 0.0 0.0
44 0.0 0.0 0.0 0.0 0.0
45 0.0 0.0 0.0 0.0 0.0
46 0.0 0.0 0.0 0.0 0.0
47 0.0 0.0 0.0 0.0 0.0
48 0.0 0.0 0.0 0.0 0.0
49 0.0 0.0 0.0 0.0 0.0
50 0.0 0.0 0.0 0.0 0.0
51 0.0 0.0 0.0 0.0 0.0
52 0.0 0.0 0.0 0.0 0.0
53 0.0 0.0 0.0 0.0 0.0
54 0.0 0.0 0.0 0.0 0.0
55 0.0 0.0 0.0 0.0 0.0
56 0.0 0.0 0.0 0.0 0.0
57 0.0 0.0 0.0 0.0 0.0
58 0.0 0.0 0.0 0.0 0.0
59 0.0 0.0 0.0 0.0 0.0
60 0.0 0.0 0.0 0.0 0.0
61 0.0 0.0 0.0 0.0 0.0
62 0.0 0.0 0.0 0.0 0.0
63 0.0 0.0 0.0 0.0 0.0
64 0.0 0.0 0.0 0.0 0.0
65 0.0 0.0 0.0 0.0 0.0
66 0.0 0.0 0.0 0.0 0.0
67 0.0 0.0 0.0 0.0 0.0
68 0.0 0.0 0.0 0.0 0.0
69 0.0 0.0 0.0 0.0 0.0
70 0.0 0.0 0.0 0.0 0.0
71 0.0 0.0 0.0 0.0 0.0
72 0.0 0.0 0.0 0.0 0.0
73 0.0 0.0 0.0 0.0 0.0
74 0.0 0.0 0.0 0.0 0.0
75 0.0 0.0 0.0 0.0 0.0
76 0.0 0.0 0.0 0.0 0.0
77 0.0 0.0 0.0 0.0 0.0
78 0.0 0.0 0.0 0.0 0.0
79 0.0 0.0 0.0 0.0 0.0
80 0.0 0.0 0.0 0.0 0.0
81 0.0 0.0 0.0 0.0 0.0
82 0.0 0.0 0.0 0.0 0.0
83 0.0 0.0 0.0 0.0 0.0
84 0.0 0.0 0.0 0.0 0.0
85 0.0 0.0 0.0 0.0 0.0
86 0.0 0.0 0.0 0.0 0.0
87 0.0 0.0 0.0 0.0 0.0
88 0.0 0.0 0.0 0.0 0.0
89 0.0 0.0 0.0 0.0 0.0
90 0.0 0.0 0.0 0.0 0.0
91 0.0 0.0 0.0 0.0 0.0
92 0.0 0.0 0.0 0.0 0.0
93 0.0 0.0 0.0 0.0 0.0
94 0.0 0.0 0.0 0.0 0.0
95 0.0 0.0 0.0 0.0 0.0
96 0.0 0.0 0.0 0.0 0.0
97 0.0 0.0 0.0 0.0 0.0
98 0.0 0.0 0.0 0.0 0.0
99 0.0 0.0 0.0 0.0 0.0
100 0.0 0.0 0.0 0.0 0.0
101 0.0 0.0 0.0 0.0 0.0
102 0.0 0.0 0.0 0.0 0.0
103 0.0 0.0 0.0 0.0 0.0
104 0.0 0.0 0.0 0.0 0.0
105 0.0 0.0 0.0 0.0 0.0
106 0.0 0.0 0.0 0.0 0.0
107 0.0 0.0 0.0 0.0 0.0
108 0.0 0.0 0.0 0.0 0.0
109 0.0 0.0 0.0 0.0 0.0
110 0.0 0.0 0.0 0.0 0.0
111 0.0 0.0 0.0 0.0 0.0
112 0.0 0.0 0.0 0.0 0.0
113 0.0 0.0 0.0 0.0 0.0
114 0.0 0.0 0.0 0.0 0.0
115 0.0 0.0 0.0 0.0 0.0
116 0.0 0.0 0.0 0.0 0.0
117 0.0 0.0 0.0 0.0 0.0
118 0.0 0.0 0.0 0.0 0.0
119 0.0 0.0 0.0 0.0 0.0
120 0.0 0.0 0.0 0.0 0.0
121 0.0 0.0 0.0 0.0 0.0
122 0.0 0.0 0.0 0.0 0.0
123 0.0 0.0 0.0 0.0 0.0
124 0.0 0.0 0.0 0.0 0.0
125 0.0 0.0 0.0 0.0 0.0
126 0.0 0.0 0.0 0.0 0.0
127 0.0 0.0 0.0 0.0 0.0
128 0.0 0.0 0.0 0.0 0.0
129 0.0 0.0 0.0 0.0 0.0
130 0.0 0.0 0.0 0.0 0.0
131 0.0 0.0 0.0 0.0 0.0
132 0.0 0.0 0.0 0.0 0.0
133 0.0 0.0 0.0 0.0 0.0
134 0.0 0.0 0.0 0.0 0.0
135 0.0 0.0 0.0 0.0 0.0
136 0.0 0.0 0.0 0.0 0.0
137 0.0 0.0 0.0 0.0 0.0
138 0.0 0.0 0.0 0.0 0.0
139 0.0 0.0 0.0 0.0 0.0
140 0.0 0.0 0.0 0.0 0.0
141 0.0 0.0 0.0 0.0 0.0
142 0.0 0.0 0.0 0.0 0.0
143 0.0 0.0 0.0 0.0 0.0
144 0.0 0.0 0.0 0.0 0.0
145 0.0 0.0 0.0 0.0 0.0
146 0.0 0.0 0.0 0.0 0.0
147 0.0 0.0 0.0 0.0 0.0
148 0.0 0.0 0.0 0.0 0.0
149 0.0 0.0 0.0 0.0 0.0
150 0.0 0.0 0.0 0.0 0.0
151 0.0 0.0 0.0 0.0 0.0
152 0.0 0.0 0.0 0.0 0.0
153 0.0 0.0 0.0 0.0 0.0
154 0.0 0.0 0.0 0.0 0.0
155 0.0 0.0 0.0 0.0 0.0
156 0.0 0.0 0.0 0.0 0.0
157 0.0 0.0 0.0 0.0 0.0
158 0.0 0.0 0.0 0.0 0.0
159 0.0 0.0 0.0 0.0 0.0
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167 0.0 0.0 0.0 0.0 0.0
168 0.0 0.0 0.0 0.0 0.0
169 0.0 0.0 0.0 0.0 0.0
170 0.0 0.0 0.0 0.0 0.0
171 0.0 0.0 0.0 0.0 0.0
172 0.0 0.0 0.0 0.0 0.0
173 0.0 0.0 0.0 0.0 0.0
174 0.0 0.0 0.0 0.0 0.0
175 0.0 0.0 0.0 0.0 0.0
176 0.0 0.0 0.0 0.0 0.0

```

Figure 28. Sample output from MCNTL1 of component material properties data (IP(64)).

## SUBROUTINE MATLF1

### General Description

Deck name: MATLF1  
Entry name: MATLF1  
Called by: MCNTL1  
Subroutines called: None

This subroutine interpolates the material file data for properties at the design temperature, and converts the tabulated stress-strain data into an approximation equation based on least squares fit. The curves through points 1, 2, 5 or 1, 3, 5 or 1, 4, 5 of the tabulated data are examined for the best fit.

### Arrays and Variables Used

D Constants (refer to Table 11)  
TMD Material properties file record date (refer to Table 22)  
TT(1) Material identification number  
TT(2) Material temperature, °F

### Arrays and Variables Calculated

TM Calculated material data (refer to Table 21)  
TT Intermediate calculations (refer to Table 25)

### Labeled Common Arrays

None

### Mass Storage File Records

None

### Error Messages

- \*\*\* MATL TEMPERATURE ERROR \*\*\* MATL NO. XXX.X THERE IS ONE TEMPERATURE ON FILE REQD TEMP = YYY.Y ASSUMED TEMP = ZZZ.Z

The foregoing message is printed when the file consists of material properties at only one temperature which does not agree with the design

temperature. The routines use the properties in the file. If this assumption is not acceptable, the file data should be corrected.

- \*\*\* MATL TEMPERATURE ERROR \*\*\* MATL NO. XXX.X TEMPERATURE IS BEYOND RANGE OF TABLE REQD TEMP = YYY.Y LAST TEMP = ZZZ.Z

The foregoing message is printed when the program extrapolates the material file data. This message may be followed by a catastrophic failure. In most cases, the extrapolation should provide acceptable results and no correction would be required. If the extrapolation results in failure or if the results are not satisfactory, the library data should be extended to include the design temperature.

#### SUBROUTINE MATLP2

##### General Description

Deck name: MATLP2  
Entry name: MATLP2  
Called by: MCNTL1  
Subroutines called: None

This subroutine is called to print the material properties of the nacelle and air induction system components for the first speed profile point if IP(63) = 0. The curve fit constants and tabulated stress-strain data are presented in the output. (See Figures 25 through 27.)

##### Arrays and Variables Used

II Counter through nine speed profile points  
KK Structural component counter

1 = duct  
2 = ramps  
3 = nacelles

MATLI Material identification number  
RM Material descriptive title  
TM Calculated material data (refer to Table 21)  
TMD Material properties file record data (refer to Table 22)

##### Arrays and Variables Calculated

None

### Labeled Common Arrays

None

### Mass Storage File Records

None

### Error Messages

None

### SUBROUTINE DSGNP

#### General Description

Deck name: DSGNP  
Entry name: DSGNP  
Called by: AISMN  
Subroutines called: None

This subroutine calculates static pressure at the inlet throat and  
hammershock pressures at both the engine face and the throat for points on  
the level-flight maximum speed and limit speed envelopes.

#### Arrays and Variables Used

ALT Nine altitudes on speed profile, ft  
D Constants (refer to Table 11)

EGTP Engine type (DATS(1))

0.0 = turbojet  
+X.X = fanjet by pass ratio

EQU Equation and physical constants (refer to Table 17)  
IP Print control (refer to "Labeled Common Arrays")  
IVG Inlet type indicator

1 = fixed duct  
2 = fixed spike  
3 = horizontal ramp

- 4 = vertical ramp
- 5 = translating spike
- 6 = translating and expanding spike

PTH Total pressure at engine on  $M_H$  diagram, psia  
 PTL Total pressure at engine on  $M_L$  diagram, psia  
 TEMH Total temperature on  $M_H$  diagram, °R  
 TEMPL Total temperature on  $M_L$  diagram, °R  
 VH Level flight maximum speed,  $M_H$ , at the nine speed profile altitudes, M  
 VL Limit speed,  $M_L$ , at the nine speed profile altitudes, M  
 XMISC Refer to "Labeled Common Arrays"

#### Arrays and Variables Calculated

PHEH Hammershock pressure at engine on  $M_H$  diagram, psia  
 PHEL Hammershock pressure at engine on  $M_L$  diagram, psia  
 PHTH Hammershock pressure at throat on  $M_H$  diagram, psia  
 PHTL Hammershock pressure at throat on  $M_L$  diagram, psia  
 PST Static absolute pressure at throat on  $M_L$  diagram, psia  
 R1H Ratio of static pressure at throat to free-stream total pressure on  $M_H$  diagram  
 R1L Ratio of static pressure at throat to free-stream total pressure on  $M_L$  diagram  
 R2H Ratio of hammershock pressure at engine face to total pressure on  $M_H$  diagram  
 R2L Ratio of hammershock pressure at engine face to total pressure on  $M_L$  diagram  
 R3H Ratio of hammershock pressure at inlet throat to total pressure on  $M_H$  diagram  
 R3L Ratio of hammershock pressure at inlet throat to total pressure on  $M_L$  diagram  
 S Intermediate calculations

#### Labeled Common Arrays

IP(65) Print/no print indicator  
     0 = print inlet pressure data (see Figure 29)  
     1 = no print  
  
 XMISC(85) Alphanumeric case title  
 to  
 XMISC(100)

3 OCT 1973

3 OCT 1973

VARI-SWEEP WING CONFIGURATION

SPEED PROFILE DESIGN CONSTANTS

BYPASS RATIO = 0.0 IVG = 4

ALT	VH	TEMP(H) DEG RANKINE	STATIC (H) PRES. RATIO	HAMMERSHOCK (H) FACE	THROAT
0.0	0.53	547.808	0.7735	1.6111	1.5671
14500.0	0.70	512.483	0.7651	1.6311	1.5757
29000.0	0.95	490.204	0.7525	1.6430	1.5661
37500.0	1.38	538.908	0.7309	1.6162	1.4927
46000.0	1.93	640.489	0.7035	1.5339	1.3372
53000.0	2.28	796.395	0.6859	1.4720	1.2219
60000.0	2.70	958.545	0.6650	1.3975	1.0793
65000.0	2.70	959.545	0.6650	1.3975	1.0793
70000.0	2.70	964.455	0.6650	1.3950	1.0774

ALT	VL	TEMP(L) DEG RANKINE	STATIC (L) PRES. RATIO	HAMMERSHOCK (L) FACE	THROAT
0.0	0.64	560.629	0.7682	1.6036	1.5534
14500.0	0.84	532.513	0.7581	1.6199	1.5540
29000.0	1.14	523.183	0.7430	1.6251	1.5299
37500.0	1.61	593.097	0.7193	1.5846	1.4318
46000.0	2.22	774.182	0.6890	1.4833	1.2430
53000.0	2.63	927.468	0.6687	1.4107	1.1051
60000.0	3.10	1141.910	0.6448	1.3279	0.9795
65000.0	3.08	1129.007	0.6461	1.3324	0.9487
70000.0	2.92	1059.650	0.6542	1.3574	1.0029

ALT	PRES(H) THROAT-PSIA	PRES(H) ENGINE-PSIA	PRES(L) THROAT-PSIA	PRES(L) ENGINE-PSIA	STATIC PRES THROAT
0.0	27.885	28.668	29.972	30.942	12.496
14500.0	18.464	19.114	20.826	21.708	9.099
29000.0	12.783	13.410	15.601	16.572	7.118
37500.0	13.914	15.065	18.313	20.268	8.644
46000.0	17.832	20.456	25.197	30.067	13.121
53000.0	19.382	23.351	28.561	36.461	16.238
60000.0	22.124	28.648	33.382	47.186	21.524
65000.0	17.398	22.529	25.588	35.937	16.371
70000.0	13.666	17.696	17.123	23.178	10.494

Figure 29. Sample output from DSGNP of inlet pressure data (IP(65)).

## Mass Storage File Records

None

## Error Messages

- \*\*\* WARNING MESSAGE \*\*\*  
RAM TEMPERATURE EXCEEDED FOR FANJET BPR = XXX.X  
RAM TEMP = YYY.Y LIMIT = ZZZ.Z
- \*\*\* WARNING MESSAGE \*\*\*  
SPEED EXCEEDED FOR ENGINE INLET COMBINATION  
BPR = XXX.X INLET TYPE = I SPEED = YYY.Y LIMIT = ZZZ.Z

These messages are printed when the condition from which the pressure calculation curves were formulated are exceeded. YYY.Y designates the actual value, and ZZZ.Z designates the applicable range of the data base.

## SUBROUTINE PRECRT

### General Description

Deck name: PRECRT  
Entry name: PRECRT  
Called by: AISMN  
Subroutines called: None

This routine determines the critical design pressure for two-dimensional variable-geometry ramps. Ramp structural material properties are also determined at the design pressure. Critical design pressure is defined by the condition which produces the maximum ratio of design pressure to material compression yield stress. Design pressure is defined as:

1. 1.5 times the hammer shock pressure for points on the level flight maximum speed,  $M_H$ , diagram
2. 1.2 times the hammer shock pressure for points on the limit speed,  $M_L$ , diagram.

### Arrays and Variables Used

ALT	Nine altitudes on speed profile, ft
D	Constants (refer to Table 11)
EQU(28)	Conversion °R to °F, 460 °R
IP	Print control, see "Labeled Common Arrays"
PHIH	Hammershock pressure at throat on $M_H$ diagram, psia
PHIL	Hammershock pressure at throat on $M_L$ diagram, psia
TEMH	Total temperature on $M_H$ diagram, °R
TEML	Total temperature on $M_L$ diagram, °R
TMS	Material properties (refer to Table 23)
VH	Level flight maximum speed, $M_H$ , at the nine speed profile altitudes, M
VL	Limit speed, $M_L$ , at the nine speed profile altitudes, M

### Arrays and Variables Calculated

DENS	DATR(14), ramp material density, lb/in. <sup>3</sup>
FACT	DATR(16), limit to ultimate design factor
FCY	DATR(12), ramp material compression yield stress at design pressure, psi
FSU	DATR(13), ramp material ultimate shear strength at design pressure, psi
ICRT	Critical design point on speed profile
IF4	Material properties file record number
PHS	DATR(3), critical ramp design pressure, psia
S	Intermediate calculations
XMAT	DATR(15), material type identification

1.0 = aluminum  
2.0 = titanium  
3.0 = steel

### Labeled Common Arrays

IP(66) Print/no print indicator

0 = print ramp design point data (see Figure 30)  
1 = do not print

```

*** RAMP DESIGN CONDITIONS ***
POINT              7
ALTITUDE           60000.00
SPEED              3.10
TEMPERATURE - F    681.91
PRESSURE - PSIA    40.06
LIMIT TO ULT. FACTOR 1.20
COMPRESSION YIELD  83947.19
ULTIMATE SHEAR STRESS 56133.15
MATERIAL DENSITY   0.160

** PRECRT - IP(66) **

```

Figure 30. Sample output from PRECRT of ramp design criteria data (IP(66)).

### Mass Storage File Records

Read by routine:

Records 109 through 117

Written by routine:

None

### Error Messages

None

### SUBROUTINE RAMPS

#### General Description

Deck name: RAMPS  
Entry name: RAMPS  
Called by: AISMN  
Subroutines called: None

This subroutine calculates two-dimensional variable-geometry ramp structure weights for either two-, three-, or four-ramp systems. Methods described in Section II of this volume are used to calculate component weights for either stiffened sheet construction or honeycomb panel structure.

#### Arrays and Variables Used

ALPHA2	Refer to Table 10
ALPHA3	Refer to Table 10
CONST	Refer to Table 10
DADH	Refer to Table 10
DATR	Refer to Table 15
DCORE	Refer to Table 10
DENS	Refer to Table 10
DR	Refer to Table 15
F	Refer to Table 18
FCT	Refer to Table 10
FCY	Refer to Table 10
FSU	Refer to Table 10
GAMMA	Refer to Table 10

IP	Printed control (refer to "Labeled Common Arrays")
PHS	Refer to Table 10
SIGMAR	Refer to Table 10
TBARFA	Refer to Table 10
TBARFS	Refer to Table 10
TBARRA	Refer to Table 10
TBARRS	Refer to Table 10
TBARRT	Refer to Table 10
TCA	Refer to Table 10
TCS	Refer to Table 10
TCT	Refer to Table 10
TSA	Refer to Table 10
TSS	Refer to Table 10
TST	Refer to Table 10
TWA	Refer to Table 10
TWS	Refer to Table 10
TWT	Refer to Table 10
W1	Refer to Table 10
W2	Refer to Table 10
W3	Refer to Table 10
W4	Refer to Table 10
XCL	Refer to Table 10
XCT	Refer to Table 10
XFCY	Refer to Table 10
XFSU	Refer to Table 10
XHTA2	Refer to Table 10
XHTA3	Refer to Table 10
XHTA4	Refer to Table 10
XHT2	Refer to Table 10
XHT3	Refer to Table 10
XHT4	Refer to Table 10
XIL1	Refer to Table 10
XIL2	Refer to Table 10
XIL31	Refer to Table 10
XIL32	Refer to Table 10
XIL33	Refer to Table 10
XIL41	Refer to Table 10
XIL42	Refer to Table 10
XIL43	Refer to Table 10
XIL44	Refer to Table 10

XIM21	Refer to Table 10
XIM22	Refer to Table 10
XIM31	Refer to Table 10
XIM32	Refer to Table 10
XIM33	Refer to Table 10
XIM41	Refer to Table 10
XIM42	Refer to Table 10
XIM43	Refer to Table 10
XIM44	Refer to Table 10
XITAA4	Refer to Table 10
XITAH4	Refer to Table 10
XITA2	Refer to Table 10
XITA3	Refer to Table 10
XITFA4	Refer to Table 10
XITFH2	Refer to Table 10
XITFH3	Refer to Table 10
XITH4	Refer to Table 10
XIT21	Refer to Table 10
XIT31	Refer to Table 10
XIT32	Refer to Table 10
XIT41	Refer to Table 10
XIT42	Refer to Table 10
XIT43	Refer to Table 10
XK21	Refer to Table 10
XK22	Refer to Table 10
XK31	Refer to Table 10
XK33	Refer to Table 10
XK41	Refer to Table 10
XK42	Refer to Table 10
XK43	Refer to Table 10
XK44	Refer to Table 10
XL1	Refer to Table 10
XL2	Refer to Table 10
XL3	Refer to Table 10
XL4	Refer to Table 10
XMAT	Refer to Table 10
XNUM	Refer to Table 10
XP21	Refer to Table 10
XP22	Refer to Table 10
XP31	Refer to Table 10
XP32	Refer to Table 10
XP33	Refer to Table 10
XP41	Refer to Table 10
XP42	Refer to Table 10
XP43	Refer to Table 10
XP44	Refer to Table 10
XW	Refer to Table 10

## Arrays and Variables Calculated

AACT	Refer to Table 10
ACT	Refer to Table 10
AHINGE	Refer to Table 10
BNUM	Number of transverse members
CG	Cosine of angle between projected face of ramp 2 and ramp 3 of four-ramp system
CS	Cosine of angle between projected face of ramp 3 and ramp 4 of four-ramp system
FACT	Refer to Table 10
FHINGE	Refer to Table 10
GAMMAR	Angle between projected face of ramp 2 and ramp 3 of four-ramp system, radians
HL	Panel depth, in
HT	Panel depth, in.
HTA	Actuator beam depth, in.
I	Scratch counter
IND	Minimum weight calculation counter
INONE	Predefined data usage indicator
	0 = predefined data used
	1 = certain predefined variables changed by user input, print revised data information
MAT	Material type indicator
	1 = aluminum
	2 = titanium
	3 = steel
N	Scratch counter
P1	Differential pressure on ramp 1, psig
P2	Differential pressure on ramp 2, psig
P3	Differential pressure on ramp 3, psig
P4	Differential pressure on ramp 4, psig
R	Actuator reaction for two-ramp system, lb
RA	Aft hinge reaction on ramp 2 of two-ramp system, lb
RA3	Aft hinge reaction on ramp 3, lb
RF	Forward hinge reaction on ramp 2 of two-ramp system, lb
RF3	Forward hinge reaction on ramp 3, lb
R1	Actuator reaction on ramp 1 of three- or four-ramp system, lb
R1LONG	Refer to Table 10

R1TRAN	Refer to Table 10
R2	Forward actuator reaction on ramp 3, lb
R2LONG	Refer to Table 10
R2TRAN	Refer to Table 10
R3	Aft actuator reaction on ramp 3, lb
R3LONG	Refer to Table 10
R4LONG	Refer to Table 10
R4TRAN	Refer to Table 10
SG	Sine of angle between projected face of ramp 2 and 3 of four-ramp system
SIGMAR	Angle between projected face of ramp 3 and ramp 4 of four-ramp system, radians
SS	Sine of angle between projected face of ramp 3 and ramp 4 of four-ramp system
TBARF	Minimum front sheet thickness, in.
TBARR	Minimum rear sheet thickness, in.
TC	Minimum cap thickness, in.
TG	Tangent of angle between projected face of ramp 3 and ramp 4 of four-ramp system
TOTAL	Refer to Table 10
TS	Minimum honeycomb facesheet thickness, in.
TW	Minimum web thickness, in.
VAVG	Design shear, for ramp 3 of four-ramp system, lb
V1	Force on ramp 1 due to differential pressure, lb
V2	Force on ramp 2 due to differential pressure, lb
V3	Force on ramp 3 due to differential pressure, lb
V4	Force on ramp 4 due to differential pressure, lb
W	Panel width, in.
WTMA	Minimum actuator beam weight, lb
WTMH	Minimum hinge beam weight, lb
WTML	Minimum panel weight, lb
WTML1	Minimum ramp 1 panel weight, lb
WTML2	Minimum ramp 2 panel weight, lb
WTML3	Minimum ramp 3 panel weight, lb
WTML4	Minimum ramp 4 panel weight, lb
WMT	Minimum transverse beam(s) weight, lb
WMTA	Minimum actuator beam weight, lb
WMT1	Minimum ramp 1 transverse beams weight, lb
WMT2	Minimum ramp 2 transverse means weight, lb
WMT4	Minimum ramp 4 transverse beams weight, lb
XIM	Minimum weight correlation factor
XL	Panel length, in.
XMAFT	Bending moment at aft actuator location on ramp 3, in.-lb.
XMAVG	Design bending moment for ramp 3 of four-ramp system, in.-lb.

XMC	Bending moment at midspan on ramp 3, in.-lb.
XMFWD	Bending moment at forward actuator location on ramp 3, in.-lb.
Z1	Shear at point on ramp 3, lb
Z2	Shear at point on ramp 3, lb
Z3	Shear at point on ramp 3, lb
Z4	Shear at point on ramp 3, lb
Z5	Shear at point on ramp 3, lb
Z6	Shear at point on ramp 3, lb

### Labeled Common Arrays

IP (67) Print/no print indicator

0 = print ramp predefined variables, input variables,  
and weight and load summary (see Figure 31)  
1 = do not print

### Mass Storage File Records

None

### Error Messages

None

### SUBROUTINE SPIKE

#### General Description

Deck name:	SPIKE
Entry name:	SPIKE
Called by:	AIMN
Subroutines called:	None

This routine calculated the weight of three-dimensional inlet throat area control spikes. Statistical equations are used to calculate these weights.

## RAMPS - IP(67) ##

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BUILT-IN PARAMETERS		
21	CL	0.900
22	PERCENT OF COMPRESSION YIELD	0.500
23	PERCENT OF SHEAR ULTIMATE	0.500
24	XV	0.200
25	CT	0.900
26	DENSITY OF CORE (PSF)	4.400
27	DENSITY OF ADHESIVE (PSF)	0.100
## 3 RAMP SYSTEM ##		
45	INDEX RAMP 1 LONGITUDINAL	1.000
46	INDEX RAMP 1 TRANSVERSE	1.000
47	INDEX RAMP 1 MINIMUM GAGE	1.000
48	INDEX RAMP 2 LONGITUDINAL	1.000
49	INDEX RAMP 2 TRANSVERSE	1.000
50	INDEX RAMP 2 MINIMUM GAGE	1.000
51	INDEX RAMP 3 LONGITUDINAL	1.000
52	INDEX RAMP 3 FWD HINGE BEAM	1.000
53	INDEX RAMP 3 ACTUATOR BEAM	1.000
54	INDEX RAMP 3 AFT HINGE BEAM	1.000
55	INDEX RAMP 3 MINIMUM GAGE	1.000
56	PERCENT HAMMERSHOCK RAMP 1	0.200
57	PERCENT HAMMERSHOCK RAMP 2	0.500
58	PERCENT HAMMERSHOCK RAMP 3	0.400
59	K21	0.900
60	K32	0.200
61	K33	0.800
62	H31	0.100
63	H32	0.100
64	H33	0.070
65	HT3	0.100
66	HTA3	0.150
67	ANGLE RAMP 2 - RAMP 3	30.000

Figure 31. Sample output from RAMPS of design constants, reaction forces, and detail weights (IP(67)).

\*\* RAMPS - IP(67) \*\*

\*\* MINIMUM GAGES \*\*

CC	ALUMINUM	TC	
100	ALUMINUM	TW	0.040
101	ALUMINUM	TS	0.020
102	ALUMINUM	TRADE	0.015
103	ALUMINUM	TRADE	0.040
104	TITANIUM	TC	0.010
105	TITANIUM	TW	0.025
106	TITANIUM	TS	0.013
107	TITANIUM	TRADE	0.010
108	TITANIUM	TRADE	0.025
109	STEEL	TC	0.010
110	STEEL	TW	0.020
111	STEEL	TS	0.010
112	STEEL	TRADE	0.010
113	STEEL	TRADE	0.020
114	STEEL	TRADE	0.010

# INPUT DATA

NUMBER OF RAMPS	3.00
CONST INP (0=STND, 1=H(JMB)	0.0
HAMMERSHOCK PRESSURE (PST)	40.06
LENGTH OF RAMP 1 (IN)	58.00
LENGTH OF RAMP 2 (IN)	90.00
LENGTH OF RAMP 3 (IN)	104.00
LENGTH OF RAMP 4 (IN)	0.0
WIDTH OF RAMP 1 (IN)	56.00
WIDTH OF RAMP 2 (IN)	96.00
WIDTH OF RAMP 3 (IN)	56.00
WIDTH OF RAMP 4 (IN)	0.0
FCV (PST)	23947.19
FSH (PST)	6133.15
DENSITY OF MATERIAL (19/CU IN)	0.16
MATERIAL (1=AL, 2=TI, 3=ST)	2.00
LIMIT TO ULTIMATE FACTOR	1.20

# CHANGES TO RUILT-IN PARAMETERS

\*\* NONE \*\*

Figure 31. Sample output from RAMPS of design constants, reaction forces, and detail weights (IP(67)) (cont).

00 RAMPS - IP(67) 00

REACTION FORCES (LBS)

RAMP 1 ACTUATOR	133743.
RAMP 3 ACTUATOR	417161.
RAMP 3 FWD HINGE	99913.
RAMP 3 AFT HINGE	150384.

RAMP WEIGHTS (LBS)

RAMP 1 - LONGITUDINAL	81.93
RAMP 1 - TRANSVERSE	28.86
RAMP 2 - LONGITUDINAL	214.24
RAMP 2 - TRANSVERSE	49.19
RAMP 3 - LONGITUDINAL	1451.67
RAMP 3 - FORWARD HINGE	28.40
RAMP 3 - ACTUATOR	95.96
RAMP 3 - AFT HINGE	42.75
TOTAL	1993.01

Figure 31. Sample output from RAMPS of design constants, reaction forces, and detail weights (IP(67)) (concl).

### Arrays and Variables Used

D	Constants (refer to Table 11)
DATS(1)	Number of nacelles
DATS(4)	Capture area per inlet, in. <sup>2</sup>
DATS(5)	Number of inlets per air vehicle
DATS(6)	Distance, leading edge of inlet to throat, in.
EQU(29)	Fixed spike weight estimate constant
EQU(30)	Translating spike weight estimate constant
EQU(31)	Translating and expanding spike weight estimate constant
IVG	Inlet type

1 = fixed duct  
2 = fixed spike  
3 = horizontal ramp  
4 = vertical ramp  
5 = translating spike  
6 = translating and expanding spike

### Arrays and Variables Calculated

S(1)	Fraction of spike weight per nacelle
SUMM(13)	Weight of fixed spike per nacelle (per vehicle for fuselage mounted engines), lb
SUMM(14)	X-CG of fixed spike relative to inlet leading edge, in.
SUMM(15)	Weight of translating spike per nacelle (per vehicle for fuselage mounted engines), lb
SUMM(16)	X-CG of translating spike relative to inlet leading edge, in.
SUMM(17)	Weight of translating and expanding spike per nacelle (per vehicle for fuselage mounted engines), lb
SUMM(18)	X-CG of translating and expanding spike relative to inlet leading edge, in.
WFTS	TOT (36), weight of translating spike per nacelle, lb
WHFS	TOT (35), weight of fixed spike per nacelle, lb
WTES	TOT (37), weight of translating and expanding spike per nacelle, lb

### Labeled Common Arrays

None

### Mass Storage File Records

None

## Error Messages

None

## SUBROUTINE DUCTS

### General Description

Deck name: DUCTS  
Entry name: DUCTS  
Called by: AISMN  
Subroutines called: DCTGEO, FRMND3, FRMELD, DUCPNL, DUCFRM, DUCWET

This subroutine controls the inlet duct weight estimating procedure by calling geometry and design synthesis routines. Subroutine DCTGEO is called to calculate geometry data at each of the duct cuts. The routine then controls the synthesis calculations starting at the first complete duct section and proceeding through the last cut. Subroutines FRMND3, FRMLD, DUCPNL, and DUCFRM are called to synthesize duct panel and frame structure at each of the duct cuts. The synthesis cut counter, either I or L, is stored in common for use by these routines.

Duct frame spacing search is performed at each duct cut. The type of program operation is defined by input frame spacing data. If a thousand has been added to the desired frame spacing, a fixed spacing is indicated. Frame spacing search is indicated by an input minimum spacing. The search starts at this minimum and progresses at fixed spacing increments until the combined weight of ducts and frames increases with increased spacing. A final pass is then made at the spacing prior to that which produced an increase in weight. Should the initial spacing or any intermediate spacing exceed the predefined maximum, the search is abbreviated at the maximum spacing. The indicator IFRM is used to direct the search process as follows:

IFRM = 1 Initial spacing pass  
IFRM = 2 Second or subsequent spacing pass  
IFRM = 3 Final spacing or fixed spacing pass

Subroutine DUCWET is called to calculate duct weight based on the sizing data. DUCWET also calculates the weight of one-dimensional inlet leading structure. Weight correlation factors are applied to the resultant weights which are then summarized in the SUMM array. Duct structure center-of-gravity calculations assume longitudinal segment weight centroids to be midway between bounding cuts. Leading edge structure center of gravity is assumed to be located at two thirds of the leading edge segment length.

### Arrays and Variables Used

AA	Unit internal axial load at frame segment centroids, lb/(lb/in.)
BB2	Frame cap width at frame segment centroids, in.
BEN	Unit internal bending, moment at frame segment centroids, in.-lb/(lb/in.)
BLD	Lower sector duct panel peripheral length at cuts, in.
BSD	Side sector duct panel peripheral length at cuts, in.
BUD	Upper sector duct panel peripheral length at cuts, in.
D	Constants (refer to Table 11)
DATD	Duct geometry and design data (refer to Table 12)
DATK(1)	Duct weight index factor
DLXD	Duct segment lengths between cuts, in.
DOD	Vertical flat length of duct contour at cuts, in.
FRWT	Weight of one frame at duct cuts, lb.
IGD	Duct leading edge type indicator
	0 = complete section
	1 = vertical lip
	2 = horizontal lip
IP	Print control, see labeled common arrays
ROD	Corner radius of duct contour at cuts, in.
SFD	Surface area of duct segments, in. <sup>2</sup>
TC	Duct panel field thickness at cuts, in.
TCC	Frame cap thickness at frame segment centroids, in.
TL	Duct panel land thickness at cuts, in.
TOT	Weight summary data (refer to Table 24)
TWV	Frame web thickness at frame segment centroids, in.
VV	Unit internal shear at frame segment centroids, lb/(lb/in.)
WOD	Horizontal flat length of duct contour at cuts, in.
WTD	Duct segment weights, lb.
WTLP	TOT (23), Weight inlet lip per nacelle, lb.
XMISC	Refer to "Labeled Common Arrays"

### Arrays and Variables Calculated

FD	S(41), frame depth, in.
I	Duct synthesis cut counter
IC	Number of frame cuts
IFF	Number of frame segments
IFRM	Frame spacing search pass counter

IQ     Number of frame segments per quadrant  
 KC     Duct perimeter code  
         1 = perimeter input  
         2 = perimeter correction factor input  
  
 L     Duct synthesis cut counter  
 NC     Number of input duct cuts  
 S(1)   Summation of duct weight times X-arms, in.-lb  
 SFRM   Duct frame spacing at duct cuts, in.  
 SUMM   Weight summary (refer to Table 20).  
 TOT    Weight summary (refer to Table 24)

#### Labeled Common Arrays

IP(69)     Print/no print indicator  
             0 = print detail duct frame, geometry, and sizing data  
                     (Figures 32 and 33)  
             1 = do not print  
  
 XMISC(85)   Alphanumeric case title  
 XMISC(100)

#### Mass Storage File Records

None

#### Error Messages

None

#### SUBROUTINE DCTGEO

#### General Description

Deck name:            DCTGEO  
 Entry name:           DCTGEO  
 Called by:            DUCTS  
 Subroutines called:   None

This subroutine calculates shape parameters at the duct cuts and length, and surface area for segments bounded by cuts. The surface area is calculated for the total number of ducts in the fuselage or, for podded engines, the total number of ducts in a nacelle.

3 OCT 1973

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# VARI-SWEEP WING CONFIGURATION

\*\*\* DUCT GEOMETRY - SECTION DATA \*\*\*  
LIP TYPE = 1 SHAPE CODE = 1

CUT	STA.	DEPTH	WIDTH	PER.	DO	RO	WD	RL	RS
1	0.0	99.00	0.0	99.00	0.0	0.0	0.0	0.0	0.0
2	190.00	99.00	80.00	358.00	49.53	0.0	40.00	90.00	99.00
3	280.00	99.00	83.00	364.00	49.50	0.0	41.50	93.00	99.00
4	510.00	99.00	100.00	398.00	49.53	0.0	50.00	100.00	99.00
5	679.00	82.00	149.00	430.00	23.53	17.47	56.53	140.50	74.50
6	680.00	82.00	74.00	212.00	41.00	0.0	37.00	74.00	82.00
7	806.00	72.00	72.00	226.20	0.00	36.00	0.00	56.55	56.55

CUT	STA.	FR.SP.	FR.WT.	LAND	RASIC
1	0.0	0.0	0.0	0.0	0.0
2	190.00	10.00	93.72	0.4319	0.1727
3	280.00	10.00	93.49	0.4319	0.1727
4	510.00	10.00	109.49	0.5182	0.2850
5	679.00	10.00	240.00	0.5936	0.4157
6	680.00	10.00	78.86	0.5941	0.4165
7	806.00	10.00	23.75	0.6496	0.5330

SFG	LFNGTH	AREA	WT COVER
1	190.00	34010.00	0.0
2	90.00	32490.00	847.10
3	230.00	87630.00	2919.13
4	169.00	63966.00	4407.81
5	1.00	624.00	53.61
6	126.00	67813.19	5383.31

WEIGHT LIP = 944.72

TOTAL 806.00 292533.19 13610.97

Figure 32. Sample output from DUCTS of unit internal frame loads and frame sizing data (IP(69)).

```

** DUCTS - IP(69) **

SECTION 2
      K      TW      TCC      BBZ      BEN      VV      AA
1      0.6132008E-01      0.3294829E-01      0.4477990E+01      -0.2383214E+02      0.4950063E+01      0.4949971E+02
2      0.8843869E-01      0.6595653E-01      0.6000000E+01      0.3137300E+03      0.2695704E+02      0.4949971E+02
3      0.9143013E-01      0.6849074E-01      0.6000000E+01      0.3337800E+03      -0.2966780E+02      0.4873637E+02
4      0.8843839E-01      0.4127844E-01      0.5610140E+01      -0.1504861E+03      -0.2684973E+02      0.4000003E+02
5      0.6131938E-01      0.8525056E-01      0.6000000E+01      -0.4774431E+03      -0.8949737E+01      0.4000003E+02
6      0.6132061E-01      0.8524978E-01      0.6000000E+01      -0.4774390E+03      0.8950286E+01      0.4000003E+02
7      0.8843899E-01      0.4127741E-01      0.5610001E+01      -0.1504727E+03      0.2695029E+02      0.4000003E+02
8      0.9143060E-01      0.6849319E-01      0.6000000E+01      0.3337969E+03      0.2966835E+02      0.4873654E+02
9      0.8843869E-01      0.6595963E-01      0.6000000E+01      0.3137500E+03      -0.2695704E+02      0.4950026E+02
10     0.6132008E-01      0.3294656E-01      0.4477757E+01      -0.2381250E+02      -0.8950063E+01      0.4950026E+02
11     0.6131979E-01      0.3294618E-01      0.4477705E+01      -0.2380859E+02      0.8949928E+01      0.4950026E+02
12     0.8843851E-01      0.6595963E-01      0.6000000E+01      0.3137500E+03      0.2684990E+02      0.4950026E+02
13     0.9143072E-01      0.6849259E-01      0.6000000E+01      0.3337930E+03      -0.2966840E+02      0.4973640E+02
14     0.8843899E-01      0.4127796E-01      0.5610073E+01      -0.1504802E+03      -0.2685028E+02      0.3999999E+02
15     0.6132061E-01      0.8525056E-01      0.6000000E+01      -0.4774436E+03      -0.8950286E+01      0.3999999E+02
16     0.6131938E-01      0.8525121E-01      0.6000000E+01      -0.4774482E+03      0.8949737E+01      0.3999999E+02
17     0.8843839E-01      0.4127843E-01      0.5610142E+01      -0.1504866E+03      0.2684973E+02      0.3999999E+02
18     0.9143019E-01      0.6849188E-01      0.6000000E+01      0.3337883E+03      0.2966785E+02      0.4873624E+02
19     0.8843951E-01      0.6595850E-01      0.6000000E+01      0.3137439E+03      -0.2684990E+02      0.4949971E+02
20     0.6131979E-01      0.3294678E-01      0.4477786E+01      -0.2381642E+02      -0.8949928E+01      0.4949971E+02

```

Figure 33. Sample output from DUCTS of duct detail geometry and weight data (IP(69)).

Data input to this routine consists of depth, width, lateral centroid, and either perimeter or perimeter correction factor at as many as 10 duct stations. The first cut describes geometry at the leading edge, and the last cut describes geometry at the engine face. Perimeter code, KC, is used to designate whether the perimeter or perimeter correction factor is defined. If KC is 1, the perimeter is input at the cuts. If KC is 2, the perimeter correction factor is input data, and the perimeter is calculated and substituted for the correction factors.

Input geometry describes a single duct. If the lateral centroid at a cut is a positive value, two ducts are indicated and the surface area is calculated for the two ducts. Should the lateral centroid at a cut be zero followed by a cut where the lateral centroid is a positive value, this indicates division of a single duct into two ducts. Conversely, two ducts could join to become a single duct. In either case, geometry at the aft cut is used to calculate the surface area for the segment in which the transition occurs.

In most instances, the duct leading edge is a complete section. However, should there be a one-dimensional leading edge, the single dimension is described in the input data set; the perimeter or perimeter correction factor is not input for this station. The second cut would then describe the first complete duct section. The surface area for this leading edge segment is then calculated from the geometry at the two bounding cuts. The segment longitudinal centroid is assumed to be two-thirds of the distance aft of the leading edge. The longitudinal centroid for all other segments or for a continuous leading edge segment is assumed to be midway between bounding cuts.

#### Arrays and Variables Used

D	Constants (refer to Table 11)
DATD	Duct geometry and design data (refer to Table 12)
KC	Duct perimeter code
	1 = perimeter input
	2 = perimeter correction factor input
NC	Number of input duct cuts

#### Arrays and Variables Calculated

BLD	Lower sector duct panel peripheral length at cuts, in.
BSD	Side sector duct panel peripheral length at cuts, in.
BJD	Upper sector duct panel peripheral length at cuts, in.

DATD(61)-	Duct perimeter, in., at cut; calculated when
DATD(70)	perimeter correction factor input
DLXD	Duct segment lengths between cuts, in.
DOD	Vertical flat length of duct contour at cuts, in.
IGD	Duct leading edge type indicator
	0 = complete section
	1 = vertical lip
	2 = horizontal lip
ROD	Corner radius of duct contour at cuts, in.
S	Intermediate calculations
SFD	Surface area of duct segments, in. <sup>2</sup>
WOD	Horizontal flat length of duct contour at cuts, in.

#### Labeled Common Arrays

None

#### Mass Storage File Records

None

#### Error Messages

- WARNING FROM DCTGEO IN AIR INDUCTION SYSTEM  
DUCT LIP GEOMETRY ERROR

The foregoing message is printed when a one-dimensional leading edge is indicated by zero in input location DATD (61) and neither depth or width are defined for the leading edge station. The surface area calculated for the leading edge segment represents two triangular sides and a triangular top.

- WARNING FROM DCTGEO IN AIR INDUCTION SYSTEM  
SECTION XX IS RECTANGLE OR ROUNDED RECT. CORRECTION IS Y.YYY

The foregoing warning message appears when the program encounters difficulty in fitting the shape, base on input geometry. XX locates the cut at which the difficulty occurred, and Y.YYY is the scaling factor applied to depth and width. The perimeter is assumed to be the independent variable and is not revised. Should the scaling factor indicate a significant revision, the input data should be examined for possible errors.

## SUBROUTINE FRMND3

### General Description

Deck name: FRMND3  
Entry name: FRMND3  
Called by: DUCTS  
Subroutines called: None

This subroutine calculates the duct frame node coordinates based on rounded rectangle shapes. This routine is entered to perform these calculations at each duct station, starting at the first complete duct section.

Frame synthesis cut coordinates are based on equal length segments along the duct contour. The first cut is taken at the top centerline, which also defines coordinates of the last synthesis cut.

### Arrays and Variables Used

D Constants (refer to Table 11)  
DOD Vertical flat length of duct contour at cuts, in.  
IFF Number of frame segments  
IQ Number of frame segments per quadrant  
L Duct synthesis cut location counter  
ROD Corner radius of duct contour at cuts, in.  
WOD Horizontal flat length of duct contour at cuts, in.

### Arrays and Variables Calculated

DLS Frame segment lengths at duct mold line, in.  
S Intermediate calculations  
Y Y-coordinate of frame cuts at duct mold line, in.  
YB Y-centroid of frame segments at duct mold line, in.  
Z Z-coordinate of frame cuts at duct mold line, in.  
ZB Z-centroid of frame segments at duct mold line, in.

### Labled Common Arrays

None

## Mass Storage File Records

None

## Error Messages

None

## SUBROUTINE FRMELD

### General Description

Deck name: FRMELD  
Entry name: FRMELD  
Called by: DUCTS  
Subroutines called: None

This subroutine calculates internal frame loads for a unit pressure loading by the elastic center method. A loading of 1 pound per inch normal to the duct mold line contour is assumed to be reacted by the frame. Unit internal loads are calculated at the neutral axis of frame segments. Inner frame cap coordinates at frame cuts are defined in subroutine FRMND3. These coordinates and frame depth are used to calculate neutral axis coordinates.

### Arrays and Variables Used

D Constants (refer to Table 11)  
DLS Frame segment lengths at duct mold line, in.  
FD S(41), frame depth, in.  
IC Number of frame cuts  
IFF Number of frame segments  
IP Print control, see labeled common arrays  
IQ Number of frame segments per quadrant  
L Duct synthesis cut location counter  
Y Y-coordinate of frame cuts at duct mold line, in.  
YB Y-centroid of frame segments at duct mold line, in.  
Z Z-coordinate of frame cuts at duct mold line, in.  
ZB Z-centroid of frame segments at duct mold line, in.

### Arrays and Variables Calculated

A Static lateral load at frame cuts, lb/(lb/in.)  
AA Unit internal axial load of frame segment centroids, lb/(lb/in.)  
BEN Unit internal bending moment at frame segment centroids, in.-lb/(lb/in.)  
BM Static bending moment at frame cuts, in.-lb/(lb/in.)  
BMO S(43), frame moment redundant, in.-lb/(lb/in.)  
DLSP Frame segment length at frame centroids, in.  
HO S(44), frame lateral load redundant, lb/(lb/in.)  
S Intermediate calculations  
V Static vertical load at frame cuts, lb/(lb/in.)  
VO S(45), frame vertical load redundant, lb/(lb/in.)  
VV Unit internal shear at frame segment centroids, lb/(lb/in.)  
YP Y-coordinate of frame neutral axis at cuts, in.  
YPB Z-centroid of frame segment at neutral axis, in.  
ZP Z-coordinate of frame neutral axis at cuts, in.  
ZPB A-centroid of frame segment at neutral axis, in.  
ZZS S(42), Z-centroid of elastic center, in.

### Labeled Common Arrays

IP(68) Print/no print indicator

0 = print duct frame redundants and geometry data  
1 = do not print

### Mass Storage File Records

None

### Error Messages

None

```

** FRMELD - IP(68) **

*** DUCT FRAME DATA ***

SECTION 2  UNIT REDUNDANTS  RMN = -2702.670  HJ =  49.500  VC =  0.000
DUCT PERIMETER = 342.717  PING PERIMETER = 361.572

CUT/SEC  Y  Z  YR  ZR  DLS  VP  ZP  VPR  ZPB  DLSP
1  0.0  42.500  8.950  42.500  17.900  0.0  52.500  8.950  52.500  17.900
2  17.900  42.500  26.850  42.500  17.900  17.900  52.500  27.640  52.275  19.486
3  35.800  42.500  37.900  42.650  14.329  37.381  52.050  40.177  44.123  16.812
4  40.000  35.900  41.000  26.850  17.900  42.974  36.195  42.987  27.048  18.295
5  40.000  17.900  40.000  8.950  17.900  43.000  17.900  43.000  8.950  17.900
6  40.000  0.0  40.000  -8.950  17.900  43.000  0.0  43.000  -8.950  17.900
7  40.000  -17.900  40.000  -26.850  17.900  43.000  -17.900  42.987  -27.048  18.295
8  40.000  -35.800  37.900  -42.650  14.329  42.974  -36.195  40.177  -44.123  16.812
9  35.800  -42.500  26.850  -49.500  17.900  37.381  -52.050  27.640  -52.275  19.486
10  17.900  -42.500  8.950  -49.500  17.900  17.900  -52.500  8.950  -52.500  17.900
11  0.0  -42.500  -8.950  -49.500  17.900  0.0  -52.500  -8.950  -52.500  17.900
12  -17.900  -42.500  -26.850  -42.650  17.900  -17.900  -52.500  -27.640  -52.275  19.486
13  -35.800  -42.500  -37.900  -42.650  14.329  -37.381  -52.050  -40.177  -44.123  16.812
14  -40.000  -35.900  -40.000  -26.850  17.900  -42.974  -36.195  -42.987  -27.048  18.295
15  -40.000  -17.900  -40.000  -8.950  17.900  -43.000  -17.900  -43.000  -8.950  17.900
16  -40.000  0.0  -40.000  8.950  17.900  -43.000  0.0  -43.000  8.950  17.900
17  -40.000  17.900  -40.000  26.850  17.900  -43.000  17.900  -42.987  27.048  18.295
18  -40.000  35.800  -37.900  42.650  14.329  -42.974  36.195  -40.177  44.123  16.812
19  -35.800  42.500  -26.850  49.500  17.900  -37.381  52.050  -27.640  52.275  19.486
20  -17.900  42.500  -8.950  42.500  17.900  -17.900  52.500  -8.950  52.500  17.900

```

Figure 34. Sample output from FRMELD of unit redundants and duct frame geometry (IP(68)).

## SUBROUTINE DUCPNL

### General Description

Deck name: DUCPNL  
Entry name: DUCPNL  
Called by: DUCTS  
Subroutines called: None

This subroutine calculates duct panel thickness required to satisfy strength and deflection criteria for either milled or constant thickness construction. The process consists of a systematic evaluation which starts at minimum gage and investigates each of the speed-altitude profile points in search of the designing condition.

This routine is called to perform these calculations at each duct station, starting at the first complete duct section. Throat pressures are used for duct stations forward of the inlet throat. Pressures at duct stations aft of the throat are obtained by interpolating between pressure at the inlet throat and at the engine front face.

### Arrays and Variables Used

D	Constants (refer to Table 11)
DATD	Duct geometry and design data (refer to Table 12)
DATS(6)	Distance, leading edge of inlet to throat, in.
EH	Duct material modulus of elasticity on $M_H$ diagram, psi
EL	Duct material modulus of elasticity on $M_L$ diagram, psi
EQU	Equation and physical constants (refer to Table 17)
FKTH	Duct material tensile strength under cyclic loading on $M_H$ diagram, fraction of ultimate tensile strength
FKTL	Duct material tensile strength under cyclic loading on $M_L$ diagram, fraction of ultimate tensile strength
FTUH	Duct material ultimate tensile strength on $M_H$ diagram, psi
FTUL	Duct material ultimate tensile strength on $M_L$ diagram, psi
I	Duct synthesis cut location counter
NC	Number of input duct cuts
PHEH	Hammershock pressure at engine on $M_H$ diagram, psia
PHEL	Hammershock pressure at engine on $M_L$ diagram, psia
PHIH	Hammershock pressure at throat on $M_H$ diagram, psia
PHTL	Hammershock pressure at throat on $M_L$ diagram, psia
PO	Ambient pressure at nine speed profile altitude, psf
PSL	Static absolute pressure at engine on $M_L$ diagram, psia
PST	Static absolute pressure at throat on $M_L$ diagram, psia
RHOD	Duct material density, lb/in. <sup>3</sup>
SFRM	Duct frame spacing at duct cuts, in.
XO	Duct cut stations, in. (refer to DATD)

### Arrays and Variables Calculated

IMIL     Duct panel mill indicator

         0 = panel not milled  
         1 = panel milled, lands at frames

S(1)     Interpolation factor for pressure  
S(2)     Ultimate tensile strength, psi  
S(3)     Fraction of ultimate tensile strength for cyclic loading  
S(4)     Modulus of elasticity, psi  
S(5)     Limit to ultimate design factor  
S(6)     Limit design stress, psi  
S(7)     Limit pressure at throat, psig  
S(8)     Limit pressure at engine, psig  
S(9)     Allowable panel deflection, in.  
S(10)    Limit pressure at duct cut, psig  
S(11)    Intermediate calculation  
S(20)    Intermediate calculation, panel field thickness, in.  
S(21)    Intermediate calculation, panel land thickness, in.  
S(22)    Intermediate calculation  
TC       Duct panel field thickness at duct cuts, in.  
TL       Duct panel land thickness at duct cuts, in.  
TOT(3)   Duct weight per inch of length at duct cuts, lb/in.

### Labled Common Arrays

None

### Mass Storage File Records

None

### Error Messages

None

## SUBROUTINE DUCFRM

### General Description

Deck name: DUCFRM  
Entry name: DUCFRM  
Called by: DUCTS  
Subroutines called: None

This subroutine calculates duct frame weight for a specified frame spacing and duct cut station. Weight is derived from a frame element sizing procedure based on internal loads, material properties, and fabrication minimums.

The sizing procedure consists of a systematic evaluation of internal loads due to static and hammer shock pressure at each of the nine speed profile altitudes. The lower limit in the sizing procedure is defined by initializing frame elements to fabrication minimums. Internal loads are obtained by multiplying unit internal loads, calculated by subroutine FRMELD, by design pressure and frame spacing. Throat pressures are used for duct stations forward of the inlet throat. Design pressures for stations aft of the throat are obtained by interpolation between pressures at the inlet throat and the engine front face.

### Arrays and Variables Used

AA	Unit internal axial load at frame segment centroids, lb/(lb/in.)
BEN	Unit internal bending moment at frame segment centroids, in.-lb/(lb/in.)
D	Constants (refer to Table 11)
DATS(6)	Distance leading edge of inlet to throat, in.
DLSP	Frame segment lengths at frame centroids, in.
D1	D(1), constant 1.0
D2	D(2), constant 2.0
EH	Duct material modulus of elasticity on $M_H$ diagram, psi
EL	Duct material modulus of elasticity on $M_L$ diagram, psi
FCYH	Duct material compression yield stress on $M_H$ diagram, psi
FCYL	Duct material compression yield stress on $M_L$ diagram, psi
FD	S(41), frame depth, in.
FNUH	Duct material Poisson's ratio on $M_H$ diagram
FNUL	Duct material Poisson's ratio on $M_L$ diagram
FSUH	Duct material ultimate shear strength on $M_H$ diagram, psi
FSUL	Duct material ultimate shear strength on $M_L$ diagram, psi
I	Duct synthesis cut location counter
IFF	Number of frame segments
NC	Number of input duct cuts
PHSH	Hammershock pressure at engine on $M_H$ diagram, psia

PHEH	Hammershock pressure at engine on $M_H$ diagram, psia
PHEL	Hammershock pressure at engine on $M_L$ diagram, psia
PHTH	Hammershock pressure at throat on $M_H$ diagram, psia
PHTL	Hammershock pressure at throat on $M_L$ diagram, psia
PI	$D(15)$ , constant $\pi$
PO	Ambient pressure at nine speed profile altitudes, psf
PSL	Static absolute pressure at engine on $M_L$ diagram, psia
PST	Static absolute pressure at throat on $M_L$ diagram, psia
RHOD	Duct material density, lb/in. <sup>3</sup>
SFRM	Duct frame spacing at duct cuts, in.
VV	Unit internal shear at frame segment centroids lb/(in/in.)
XO	Duct cut stations, in. (refer to DATD array Table 12)
ZERO	$D(24)$ , constant 0.0

#### Arrays and Variables Calculated

AC	$S(58)$ , frame cap area, in. <sup>2</sup>
AMI	$S(54)$ , minimum frame cap area, in. <sup>2</sup>
BB2	Frame cap width at frame segment centroids, in.
BC2	$S(62)$ , frame cap width, in.
E	$S(51)$ , frame material modulus of elasticity, psi
FCY	$S(47)$ , frame material compression yield stress, psi
FKC	$S(48)$ , frame buckling coefficient
FMJ	$S(50)$ , frame material Poisson's ratio.
FRWT	Weight of one frame at duct cuts, lb
FSU	$S(48)$ , frame material ultimate shear strength, psi
ICNT	Design pressure point counter
PAA	$S(57)$ , frame cap axial load from combined axial and bending load, lb
PAX	$S(56)$ , frame axial load, lb
RHO	$S(52)$ , frame material density, lb/in. <sup>3</sup>
S	Intermediate calculations
TCAP	$S(61)$ , frame cap thickness, in.
TCAP2	$S(63)$ , half of frame cap thickness, in.
TCC	Frame cap thickness at frame segment centroids, in.
TEM2	$S(55)$ , intermediate calculation
TOT(4)	Frame weight per inch of duct length at duct cut, in.
TW	$S(59)$ , frame web thickness, in.
TWS	$S(60)$ , frame stiffener thickness, in.
TWT	$S(67)$ , frame weight, lb
TWW	Frame web thickness at frame segment centroids, in.
WTF	$S(64)$ , frame cap weight, lb
WTST	$S(66)$ , frame stiffener weight, lb
WTW	$S(65)$ , frame web weight, lb

### Labeled Common Arrays

None

### Mass Storage File Records

None

### Error Messages

None

### SUBROUTINE DUCWET

#### General Description

Deck name: DUCWET  
Entry name: DUCWET  
Called by: DUCTS  
Subroutines called: None

This subroutine calculates inlet duct weight for each of the duct segments. Duct weight calculation is based on linear thickness taper between forward and aft boundaries of segments.

Structural arrangement is evaluated so that calculated weights account for the total duct weight in a single nacelle or, for fuselage buried engine concepts, the total duct weight in the vehicle. These calculations account for:

1. One-dimensional inlet lip
2. Variable geometry ramps
3. One or two ducts and the transition from two ducts to one

One-dimensional inlet lip structure weight is calculated on a unit weight basis. Surface area for the first inlet segment is used to calculate this structure. Variable-geometry ramps are assumed to form part of duct wall. Should ramps exist, that portion of duct which is covered by ramps is deleted in the calculation of duct panel weights. One or two ducts may exist in a nacelle or fuselage. On some configurations, the inlet system may consist

of two ducts which combine to form a single duct. Weight calculation for the segment in which this geometric transition occurs is performed by using geometry and sizing data at the aft boundary of the affected segment.

#### Arrays and Variables Used

BSD	Side sector duct panel peripheral length at cuts, in.
BUD	Upper sector duct panel peripheral length at cuts, in.
D	Constants (refer to Table 11).
DATD	Duct geometry and design data (refer to Table 12)
DATR	Ramp geometry and design data (refer to Table 15)
DLXD	Duct segment lengths between cuts, in.
EQU(96)	Duct lip unit weight, psf
IGD	Duct leading edge type indicator 0 = complete section 1 = vertical lip 2 = horizontal lip
IVG	Inlet type indicator 1 = fixed duct 2 = fixed spike 3 = horizontal ramp 4 = vertical ramp 5 = translating spike 6 = translating and expanding spike
NC	Number of input duct cuts
RHOD	Duct material density, lb/in. <sup>3</sup>
SFD	Surface area of duct segments, in. <sup>2</sup>
SFRM	Duct frame spacing at duct cuts, in.
TC	Duct panel field thickness at duct cuts, in.
TL	Duct panel land thickness at duct cuts, in.
XO	Duct cut stations, in. (refer to DATD array Table 12)

#### Arrays and Variables Calculated

S	Intermediate calculations
WTD	Duct segment weights, lb
WILP	TOT(23), weight inlet lip per nacelle, lb

#### Labeled Common Arrays

None

## Mass Storage File Records

None

## Error Messages

None

## SUBROUTINE NACELE

### General Description

Deck name: NACELE  
Entry name: NACELE  
Called by: AISMN  
Subroutines called: NCLGEO

This subroutine is called to estimate nacelle shell structure for externally mounted engine installations. Weight and balance data for nacelle panels, frames, and load redistribution members are calculated in this routine. The estimating procedure consists of the evaluation of structural minimums, local panel flutter, and duct-nacelle compatibility. Subroutine NCLGEO is called to develop the required nacelle geometry data.

The nacelle is assumed to consist of an inlet section and an engine compartment section. This distinction is made to evaluate structural arrangement differences in the two sections. In the inlet section, frame weight and spacing are determined for duct design requirements. These data are developed by the duct estimating routines. Frame weight and spacing at nacelle cuts are obtained by interpolating between bounding duct cuts. Should two inlet ducts exist at a nacelle cut, the corresponding nacelle frame is assumed to be equivalent to two duct frames. Frame spacing in the engine compartment section is defined by input nacelle data. Frame weight in the engine compartment is calculated from predefined shape and minimum thickness.

Nacelle cover thicknesses at nacelle cuts are established by minimum gage and, for supersonic aircraft, by local panel flutter requirements if critical. Critical panel flutter requirements are obtained by a systematic evaluation of mach number, dynamic pressure, and material modulus of elasticity at each of the nine speed-altitude profile points. The appropriate frame spacing is used to determine thickness required to prevent local panel flutter at each nacelle cut.

Nacelle component weights are calculated for each nacelle segment. Should the first nacelle segment geometry define a one-dimensional leading edge structure, weight for that segment is not calculated to avoid duplication since the weight for that segment is calculated as part of the inlet duct structure.

Cover weight calculations are based on linear thickness taper between the forward and aft boundaries of segments. Cover panels which are replaced by engine removal doors are deleted in these weight calculations. Frame weight within segments are based on weight per linear inch at the bounding cuts.

Load redistribution structure weight is based on nacelle profile area. This calculation is performed for multiple engine nacelle arrangements where engine loads are reacted by nacelle structure which then transfers the loads to pylons.

Weight correlation factors are applied to the resultant weights which are then summarized in the SUM array. Center-of-gravity calculations assume longitudinal segment weight centroids to be midway between bounding cuts.

#### Arrays and Variables Used

ALT	Nine altitudes on speed profile, ft
BLN	Lower sector nacelle panel peripheral length at cuts, in.
BSN	Side sector nacelle panel peripheral length at cuts, in.
BUN	Upper sector nacelle panel peripheral length at cuts, in.
D	Constants (refer to Table 11)
DATD	Duct geometry and design data (refer to Table 12)
DATK	Weight correlation factors (refer to EQU array, Table 17)
DATN	Nacelle geometry and design data (refer to Table 14)
DATS	Air induction system, nacelle, and engine section design data (refer to Table 16)
DLXN	Nacelle segment lengths between cuts, in.
DON	Vertical flat length of nacelle contour at cuts, in.
EQU	Equation and physical constants (refer to Table 17)
FRWT	Weight of one duct frame at duct cuts, lb
IGN	Nacelle leading edge type indicator 0 = complete section 1 = vertical lip 2 = horizontal lip
IP	Print control (refer to "Labeled Common Arrays")
NC	Number of input duct cuts
QL	Dynamic pressure on $M_L$ diagram, psf

RCSN	Side sector nacelle panel radius of curvature at cuts, in.
RCUN	Upper sector nacelle panel radius of curvature at cuts, in.
RON	Corner radius of nacelle contour at cuts, in.
SFN	Surface area of nacelle segments, in. <sup>2</sup>
SFRM	Duct frame spacing at duct cuts, in.
TMS	Material properties (refer to Table 23)
VL	Limit speed, $M_L$ , at nine speed profile altitudes, M
WON	Horizontal flat length of nacelle contour at cuts, in.
XMISC	Refer to "Labeled Common Arrays"

### Arrays and Variables Calculated

DATN	Nacelle flutter design data (refer to Table 14)
ELN	Nacelle material modulus of elasticity, psi
FRWN	Weight of one nacelle frame at nacelle cuts, lb
ICN	Engine support type indicator 0 = engine directly mounted to pylon or one engine per nacelle 1 = multiple engines per nacelle with engines mounted to nacelle structure
IF4	Calculated material properties file record number
KCN	Nacelle perimeter code 1 = perimeter input 2 = perimeter correction factor input
NCN	Number of input nacelle cuts
NFLT	Speed profile point critical for local panel flutter design
RHON	Nacelle material density, lb/in. <sup>3</sup>
SFRN	Nacelle frame spacing at nacelle cuts, in.
SUMM	Weight summary data (refer to Table 20)
TCN	Nacelle panel thickness at nacelle cuts, in.
TOT	Weight summary data (refer to Table 24)
WTCN	Nacelle panel weights within nacelle segments, lb
WTFN	Nacelle frame weights within nacelle segments, lb
WTLN	Nacelle load redistribution member weights within nacelle segments, lb

### Labeled Common Arrays

(IP(70)	Print/no print indicator 0 = print nacelle geometry and weight data (Figure 35) 1 = do not print
XMISC(85)	Alphanumeric case title
XMISC(100)	

3 OCT 1973

3 OCT 1973

3 OCT 1973

3 OCT 1973

\*\*\* NACELLE GEOMETRY - SECTION DATA \*\*\*

LIP TYPE = 1 SHAPE CODE = 1

CUT	STA.	DEPTH	WIDTH	NO	RO	MC	RU	RL	BS	RCU	RCS
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	100.0	110.0	170.0	55.0	0.0	50.0	100.0	100.0	110.0	0.0	0.0
3	200.0	110.0	170.0	55.0	4.7	52.3	112.0	112.0	100.0	1134.6	1054.6
4	300.0	110.0	170.0	55.0	21.0	53.0	139.0	139.0	101.0	377.9	197.4
5	400.0	110.0	170.0	55.0	16.3	67.7	161.0	161.0	103.0	659.3	266.4
6	500.0	110.0	170.0	55.0	16.3	67.7	161.0	161.0	103.0	659.3	266.4
7	600.0	110.0	170.0	55.0	29.1	60.4	166.5	166.5	97.5	388.6	130.8
8	700.0	110.0	170.0	55.0	26.8	64.2	170.5	170.5	94.5	444.5	133.8
9	800.0	110.0	170.0	55.0	28.0	63.0	170.0	170.0	90.0	422.8	91.4

CUT	STA.	FR.SP.	FR.WT.	COVER
1	0.0	0.0	0.0	0.0320
2	100.0	10.00	93.72	0.0426
3	200.0	10.00	93.69	0.0426
4	300.0	10.00	109.48	0.0425
5	400.0	10.00	740.00	0.0425
6	500.0	10.00	157.71	0.0425
7	600.0	10.00	47.51	0.0424
8	700.0	20.00	21.84	0.0421
9	800.0	20.00	20.16	0.0411

SEG	LENGTH	AREA	WT COVER	WT FP	WT LONGERON
1	190.00	19300.00	0.0	0.0	0.0
2	90.00	38700.00	263.62	843.34	0.0
3	230.00	105800.00	719.78	2336.49	0.0
4	169.00	95176.00	579.11	2953.11	0.0
5	1.00	578.00	3.59	19.89	0.0
6	126.00	66528.00	452.07	1292.84	0.0
7	204.00	107916.00	1075.64	595.98	0.0
8	77.00	39655.00	517.84	80.85	0.0
TOTAL	1087.00	463303.00	3611.64	8122.53	0.0

Figure 35. Sample output from NACELE of nacelle detail geometry and weight data (IP(70)).

## Mass Storage File Records

Read by routine:

Records 109 through 117

Written by routine:

None

## Error Messages

None

## SUBROUTINE NCLGEO

### General Description

Deck name:	NCLGEO
Entry name:	NCLGEO
Called by:	NACELE
Subroutines called:	None

This routine calculates shape parameters at the nacelle cuts, and length and surface area for segments bounded by cuts. These calculations are based on a family of shapes that may be defined by straight lines and circular arcs.

Data input to this routine consist of depth, width, and either perimeter or perimeter correction factor at as many as 10 nacelle stations. The first cut describes geometry at the inlet leading edge, and the last cut describes geometry at the last full nacelle section. Perimeter code, KCN, is used to designate whether the perimeter or perimeter correction factor is defined. If KCN is 1, the perimeter is input at the cuts. If KCN is 2, the perimeter correction factor is input data, and the perimeter is calculated and substituted for the correction factors.

For one-dimensional leading edges, the single dimension is described at the first cut; the perimeter or perimeter correction factor is not input for this station. The second cut describes the first complete nacelle section. The surface area for this segment is not calculated, since it is already accounted for in the duct calculations.

### Arrays and Variables Used

D	Constants (refer to Table 11)
DATN	Nacelle geometry and design data (refer to Table 14)
KCN	Nacelle perimeter code 1 = perimeter input 2 = perimeter correction factor input
NCN	Number of input nacelle cuts

### Arrays and Variables Calculated

BLN	Lower sector nacelle panel peripheral length at cuts, in.
BSN	Side sector nacelle panel peripheral length at cuts, in.
BUN	Upper sector nacelle panel peripheral length at cuts, in.
DATN(61)-	Nacelle perimeter at cut, in., calculated when perimeter
DATN(70)	Correction factor input
DLXN	Nacelle segment lengths between cuts, in.
DON	Vertical flat length of nacelle contour at cuts, in.
IGN	Nacelle leading-edge-type indicator 0 = complete section 1 = vertical lip 2 = horizontal lip
RCLN	Lower sector nacelle panel radius of curvature at cuts, in.
RCSN	Side sector nacelle panel radius of curvature at cuts, in.
RCUN	Upper sector nacelle panel radius of curvature at cuts, in.
RON	Corner radius of nacelle contour at cuts, in.
S	Intermediate calculations
SFN	Surface area of nacelle segments, in. <sup>2</sup>
WON	Horizontal flat length of nacelle contour at cuts, in.

### Labeled Common Arrays

None

### Mass Storage File Records

None

### Error Messages

•WARNING FROM NCLGEO IN AIR INDUCTION SYSTEM  
NACELLE LIP GEOMETRY ERROR

The foregoing message is printed when a one-dimensional leading edge is indicated by zero in input location DATN961) and neither depth or width are

defined for the leading edge station. Unit inertias are calculated for this segment, assuming a horizontal lip-type configuration.

- WARNING FROM NCLGEO IN AIR INDUCTION SYSTEM  
SECTION XX IS RECTANGLE OR ROUNDED RECT. CORRECTION IS Y.YYY

The foregoing warning message appears when the program encounters some difficulty in fitting the shape, based on input geometry. XX locates the cut at which the difficulty occurred, and Y.YYY is the scaling factor applied to depth and width. The perimeter is assumed to be the independent variable and is not revised. Should the scaling factor indicate a significant revision, input data should be examined for possible errors.

#### SUBROUTINE MISCOM

##### General Description

Deck name: MISCOM  
Entry name: MISCOM  
Called by: AISMN  
Subroutines called: None

This subroutine is called to calculate weight and balance data for miscellaneous nacelle and engine section components. Following is a list of components which are considered in this routine.

Engine mounts  
Duct by pass doors  
Auxiliary inlet doors  
Engine removal doors  
Miscellaneous access doors  
Firewall  
Nacelle exterior finish  
Engine compartment shroud

Statistical equations and rule-of-thumb methods are used to compute weight and balance data for all of the foregoing items. Engine mounts calculations are performed for all propulsion system arrangements. Tests are made to determine whether calculations for the other components are required.

##### Arrays and Variables Used

D Constants (refer to Table 11)  
DATD Duct geometry and design data (refer to Table 12)

DATN	Nacelle geometry and design data (refer to Table 14)
DATS	Air induction system, nacelle, and engine section design data (refer to Table 16)
DOD	Vertical flat length of duct contour at cuts, in.
DON	Vertical flat length of nacelle contour at cuts, in.
EQU	Equation and physical constants (refer to Table 17)
NC	Number of input duct cuts
ROD	Corner radius of duct contour at cuts, in.
RON	Corner radius of nacelle contour at cuts, in.
TOT(12)	Nacelle surface area per nacelle, in. <sup>2</sup>
WOD	Horizontal flat length of duct contour at cuts, in.
WON	Horizontal flat length of nacelle contour at cuts, in.

#### Arrays and Variables Calculated

NCN	Number of input nacelle cuts
S	Intermediate calculations
SUMM	Weight summary data (refer to Table 20)
WTAI	TOT(41), weight auxiliary inlets per nacelle, lb
WTBP	TOT(42), weight duct by pass doors per nacelle, lb
WTED	TOT(43), weight engine removal doors per nacelle, lb
WTEF	TOT(47), weight engine mounts per nacelle, lb
WTEM	TOT(40), weight engine mounts per nacelle, lb
WTFW	TOT(45), weight firewall per nacelle, lb
WIND	TOT(44), weight miscellaneous doors per nacelle, lb
WTSD	TOT(46), weight engine compartment shroud per nacelle, lb

#### Labeled Common Arrays

None

#### Mass Storage File Records

None

#### Error Messages

None

## SUBROUTINE PYLONS

### General Description

Deck name: PYLONS  
Entry name: PYLONS  
Called by: AISMN  
Subroutines called: None

This subroutine is called to calculate weight and balance data for pylons and nacelle attach fittings. Separate weight calculations are performed for inboard and outboard pylons should they exist. Attach fitting weights are calculated for the nacelle and content inertia loads. Centers of gravity for these components are based on engine center of gravity and pylon span and sweep angle.

### Arrays and Variables Used

D Constants (refer to Table 11)  
DATN Nacelle geometry and design data (refer to Table 14)  
DATS Air induction system, nacelle, and engine section design data (refer to Table 16)  
EQU Equation and physical constants (refer to Table 17)  
SUM(22) X-CG of inboard engine mounts relative to inlet leading edge, in.  
TMS Material properties (refer to Table 23)  
TOT Weight summary data (refer to Table 24)

### Arrays and Variables Calculated

IF4 Material properties file record number  
S Intermediate calculations  
SUM Weight summary data (refer to Table 20)  
WFTI TOT(53), weight inboard fittings per nacelle, lb  
WFTO TOT(54), weight outboard fittings per nacelle, lb  
WTPI TOT(51), weight inboard pylons per nacelle, lb  
WTPO TOT(52), weight outboard pylons per nacelle, lb

### Labeled Common Arrays

None

## Mass Storage File Records

Read by routine:

Record 109

Written by routine:

None

## Error Messages

None

## SUBROUTINE SUMMARY

### General Description

Deck name:	SUMARY
Entry name:	SUMARY
Called by:	AISMN
Subroutines called:	None

This subroutine performs computations which summarize weight and balance data for the air induction system, nacelle, and engine section structure. These summary results are printed as shown in Figures 3, 4, and 5.

Data provided to this routine are for component details in the inlet coordinate system. These detail data are combined to account for the proper number of items, such as number of ramps or nacelles, and to compute required balance data in the vehicle coordinate system. Summary results are organized for transfer to the labeled common array FDAT by module control routine, AISMN.

### Arrays and Variables Used

DATR	Ramp geometry and design data (refer to Table 15)
DATS	Air induction system, nacelle, and engine section design data (refer to Table 16)
IVG	Inlet type indicator
	1 = fixed duct
	2 = fixed spike

	3 = horizontal ramp
	4 = vertical ramp
	5 = translating spike
	6 = translating and expanding spike
SUMM	Weight summary data (refer to Table 20)
TOT	Weight summary data (refer to Table 24)

#### Arrays and Variables Calculated

S	Intermediate calculations
SUMM	Weight summary data (refer to Table 20)

#### Labeled Common Arrays

None

#### Mass Storage File Records

None

#### Error Messages

None

## Section IV

### REFERENCES

1. United States Committee on Extension of the Standard Atmosphere, U.S. Standard Atmosphere, 1962, Library of Congress Catalog No. 551, U.S. Government Printing Office, Washington, D.C., December 1962
2. Military Specification MIL-E-5008C, "Engines, Aircraft, Turbojets, and Turbofan, Model Specification For (Outline and Instructions For Preparation)"
3. Young, L. C., "Hammershock Status Survey," TFD-71-1486, North American Rockwell Corporation, Los Angeles, 1971
4. Roark, Raymond J., Formulas for Stress and Strain, McGraw-Hill, New York, 1954
5. Bruhn, E. F., Analysis and Design of Flight Vehicle Structures, Tri State Offset Company, Ohio, 1965
6. Crosthwait, E. L., Kennon, I. G. Jr., and Roland, H. L., "Preliminary Design Methodology For Air-Induction Systems", SEG-TR-67-1, Air Force Systems Command, WPAFB, Ohio, 1967
7. Lemley, C. E., "Design Criteria for Prediction and Prevention of Panel Flutter," Volume I, AFFDL-TR-67-140, Air Force Flight Dynamics Laboratory, WPAFB, Ohio, 1962

APPENDIX A  
AIR INDUCTION SYSTEM MODULE  
FLOW CHARTS AND  
FORTRAN LISTS

## APPENDIX A

### AUTOFLOW DESCRIPTION

The AUTOFLOW documentation system is a series of software packages owned and maintained by Applied Data Research, Inc. Rockwell International has leased a software system for use in producing flow charts on their IBM 370 system. The flow charts are drawn on a CRT, and a photograph is taken and printed on paper by Microfilm Services.

Because the AUTOFLOW system used is IBM-oriented, the function of the BUFFERIN and BUFFEROUT statements is not recognized, but these statements appear in proper order in note boxes. Also, the PROGRAM name does not appear on the main program, and library routines REALMS and WRITMS are listed as undefined external references.

The AUTOFLOW product requested for this present document includes the listing, a cross-reference list, and the flow charts.

#### LISTING

AUTOFLOW produces an 80-column listing of all the cards in the program. The cards are sequenced and grouped by routine.

#### CROSS-REFERENCE LIST

This list is broken into two parts.- procedural statements and nonprocedural statements. The procedural statements cross-reference list gives the inter-connections which will appear on the flow charts. The presentation lists the following from left to right:

- The card identification from columns 73 through 80 of this card, or card sequence number. When sequence number is used in place of card identification, it is enclosed in parentheses.
- The page and box number where this card is displayed in a flow chart.
- The FORTRAN statement number from columns 1 through 5 of this card.
- The card identification from columns 73 through 80 of the card referring to this card, or sequence number.
- The page and box number where the card referring to this card is displayed in a flow chart.

(The last two items are repeated for each reference until the list is exhausted.)

Those cards which are not referred to in the procedural list are listed between the flow charts. Typical in the lists are type statements, dimension statements, equivalence statements, common block statements, format statements, and data statements. This comprises the nonprocedural statements used in FORTRAN.

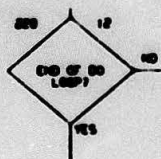
## FLOW CHARTS

The flow charts produced by AUTOFLOW use USASI conventional symbols. Since the flow charts are mechanically drawn from the program source deck, there are no omissions or vague generalizations about the processing within the boxes.

Every box on each page is uniquely numbered and may be referred to from elsewhere in the program. The source of a reference to a box will be indicated by showing the page and box number. If the number is followed by an asterisk, there are multiple references to this point, and the others may be found by using the cross-reference list.



The most-often-used symbol is the decision box. Like all boxes, its box number is above and to the right of the box. Its FORTRAN statement number is above and to the left of the box. The decision choices for the paths are printed.



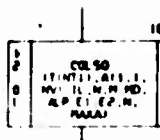
The unconditional transfer connector has its page number destination printed above or to the left of the box number destination within the connector. If there is a FORTRAN statement number at the destination, it is printed below the connector.



The exit box example shows a connector from page 9, box 15.



The subroutine call box includes the calling sequence. The page and box numbers of the flow chart of the called subroutine are shown on the left-hand side of the box. The page number is above the box number.



The note box encloses comments of a functional nature,



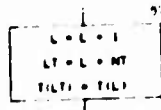
as differentiated from the 21 column comments, which are left justified without a box, that show the comment cards included in the FORTRAN deck.

```

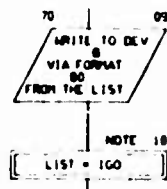
      1001
CALLING PROGRAM
AREA 01 0100,01
CIRC 01
OPERATION
CIRCUIT 0100,01,0101
0100,01
      1002
CALLING PROGRAM
AREA 01 0100,01
CIRC 01
OPERATION
CIRCUIT 0100,01,0101
0100,01 0100,01

```

The process box is used to enclose FORTRAN arithmetic statements.



Input and output are shown as communicating with a device. The list used follows, if appropriate:



The computed  $\overline{M} \overline{M}$  becomes a branch table showing the page and box number of each of the ordered brances.

COMPUTED GO TO FOR 100		87
10	25	25.08
25		25.12

The column connectors and initial connectors are the only boxes without external box numbers. The function of the initial connector is always clear, but the label given is the symbol in the next FORTRAN card, which is often blank.



The column connector identifies the page and box number to which it connects.



TABLE OF CONTENTS  
FOR  
AUTOFLOW CHART SET

PORTMAN MODULE AIR INDUCTION SYSTEM MODULE

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - PROCEDURES

(000000) 0.00 1010	(000000) 0.03	(000000) 0.03
(000000) 0.00	(000001) 0.00	
(000001) 0.00 00		
(000000) 0.00 40		
(000000) 0.11 0003		
(000110) 0.21 0000	(000003) 0.10	
(000102) 0.24 00		
(000123) 0.20 00	(000121) 0.23	
(000100) 0.03 07		
(000100) 0.04 100	(000100) 0.03	(000100) 0.03
(000100) 0.00 101		
(000100) 0.00 102	(000100) 0.24	(000100) 0.04
(000100) 0.11	(000100) 0.00	
(000100) 0.13 140		
(000100) 0.13	(000100) 0.14	
(000141) 4.01 000	(000100) 0.03	(000100) 0.03 (000100) 0.03
(000142) 4.02 000	(000100) 0.03	(000100) 0.14
(000144) 4.04 010		
(000140) 4.00 000	(000143) 4.03	
(000147) 4.07 070		
(000140) 4.00 400	(000140) 4.00	
(000101) 4.10 1010	(000100) 0.07	
(000100) 4.10 1000	(000100) 4.14	(000100) 4.14

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE DETAIL

(000170) 0.01 OCT00	(000753) 00.00-X	
(000100) 0.00 10	(000100) 0.01	
(000100) 0.03	(000001) 0.00	
(000000) 0.04 10		
(000001) 0.00 10	(000100) 0.03	
(000003) 0.00 00	(000100) 0.01	
(000004) 0.07	(000001) 0.10	
(000000) 0.00 00	(000004) 0.07	
(000011) 0.00 04	(000000) 0.00	
(000010) 0.10 00		
(000010) 0.11 00	(000011) 0.00	
(000000) 0.01 00	(000000) 0.00	
(000010) 0.00 100	(000004) 0.07	
(000003) 0.04 101		
(000000) 0.00 102	(000000) 0.03	
(000011) 0.00 100		
(000000) 0.00 1000	(000007) 0.00	
(000000) 0.11 110	(000000) 0.07	
(000002) 0.13 111		
(000003) 0.14 112	(000011) 0.10	
(000004) 0.10 114		
(000000) 0.10 110	(000003) 0.14	
(000001) 0.10 000	(000010) 0.11	(000010) 0.01
(000000) 10.01 000	(000000) 0.00	
(000000) 10.00 000		
(000000) 10.04 000	(000007) 10.00	
(000000) 10.00 010	(000000) 10.00	
(000000) 10.00 004	(000007) 10.04	
(000000) 10.07 000	(000000) 0.00	(000000) 10.00 (000003) 11.00 (000000) 11.00 (000004) 11.04
(000000) 10.00	(000000) 11.00	
(000000) 10.10 000		
(000000) 10.11 000		
(000000) 10.10 070	(000000) 10.10	
(000000) 10.10 000	(000001) 10.00	

03/26/74	TABLE OF CONTENTS AND REFERENCES		AUTOFLEX CHART SET - BEEP		PAGE 8
CARD NO	PAGE/ROW	NAME	REFERENCES (SOURCE SEQUENCE NO. AND PAGE/ROW)		
(000007)	10.14	200	(000000)	10.10	
(000008)	11.01	200	(000000)	10.03	
(000009)	11.02	207	(000000)	11.01	
(000010)	11.03	200	(000000)	11.01	
(000075)	11.04	202	(000071)	10.04	
(000091)	11.05	204	(000000)	10.13	
(000092)	11.06	200	(000000)	10.12	(000000) 10.14

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE BEEP

(000328)	14.01	BEEP	(000125)	3.02-X				
(000340)	14.02		(000300)	10.17				
(000300)	14.05	10	(000340)	14.04				
(000304)	15.01	20	(000340)	14.04				
(000306)	15.02	22	(000304)	15.01				
(000308)	15.05	24						
(000301)	15.07	50	(000302)	14.08	(000300) 10.04	(000304) 10.05	(000300) 10.04	(000371) 10.05
(000305)	15.01	30	(000304)	15.01				
(000307)	15.02	32	(000305)	15.01				
(000370)	15.05	34						
(000375)	15.07	40	(000305)	15.01				
(000370)	15.10	42						
(000303)	15.12	50	(000301)	15.07				
(000304)	15.13	50						
(000309)	15.15	50	(000301)	15.07	(000303) 15.12			
(000308)	15.17	200	(000377)	15.00	(000370) 15.11			
(000401)	15.18		(000400)	17.01				
(000400)	17.01	210						
(000400)	17.03	2000						
(000433)	17.15	000	(000400)	17.02				

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE BEEP

(000411)	20.01	BEEP	(000770)	20.05-X				
(000400)	20.02	130						
(000400)	20.04	140	(000404)	20.01				
(000500)	20.05	150	(000407)	20.03				
(000504)	20.07		(000507)	20.00				
(000507)	20.08	170						
(000511)	20.10		(000570)	21.13				
(000514)	20.11	200						
(000577)	20.15	220	(000571)	21.12				
(000530)	20.16	240	(000571)	21.12				
(000545)	20.20	300	(000544)	20.14	(000530) 20.17			
(000547)	20.20		(000570)	21.11				
(000500)	20.25	400						
(000500)	20.27	410	(000500)	20.24				
(000500)	21.01	400	(000507)	20.25				
(000500)	21.03		(000500)	21.01				
(000500)	21.05		(000500)	21.03				
(000500)	21.05		(000504)	21.05				
(000500)	21.10	440						
(000570)	21.11	500	(000507)	21.00				
(000570)	21.13	000	(000571)	21.12				
(000570)	21.15		(000500)	21.15				
(000500)	21.15	010						

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE BEEP

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AUTOFLSH CHART SET - SHEEP  
REFERENCES (SOURCE SEQUENCE NO. AND PAGE/SEN)

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CARD ID	PAGE/SEN	NAME	REFERENCES
(000007)	24.01	SUCPIL	(000771) 25.04-X
(000027)	24.02	130	
(000030)	24.03	140	(000026) 24.01
(000032)	24.04	200	(000030) 24.02
(000033)	24.05		(000004) 25.01
(000040)	24.06	310	
(000040)	24.10	320	(000044) 24.08
(000050)	24.12	330	
(000052)	24.14	340	(000040) 24.11
(000054)	24.17		(000053) 24.15
(000057)	24.20		(000055) 24.18
(000060)	24.22		(000057) 24.20
(000061)	24.23	360	(000053) 25.20
(000065)	24.27		(000057) 24.25
(000067)	25.01		(000055) 25.11
(000068)	25.03		(000057) 25.01
(000071)	25.04	380	(000053) 25.20
(000080)	25.08		(000070) 25.08
(000081)	25.09	390	(000080) 24.22 (000080) 24.27
(000085)	25.11	392	
(000088)	25.13	394	(000085) 25.18
(000089)	25.16	395	(000088) 25.03
(000091)	25.18		(000090) 25.14
(000092)	25.19		(000091) 25.16
(000093)	25.20		(000092) 25.18
(000094)	25.21	400	

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE BUCKS

(000747)	28.01	BUCKS	(000142) 4.02-X
(000755)	28.04		(000755) 28.10
(000757)	28.05	10	
(000758)	28.07	20	(000755) 28.05
(000762)	28.11	200	
(000764)	28.12	250	(000761) 28.10
(000767)	28.01	300	(000763) 28.11 (000770) 28.08 (000763) 28.11
(000768)	28.02	310	
(000770)	28.03	400	(000765) 28.12 (000767) 28.01 (000765) 28.12
(000774)	28.07	410	
(000775)	28.08	420	
(000776)	28.09	430	(000774) 28.07
(000781)	28.11	440	
(000784)	28.12	450	(000780) 28.10
(000785)	28.13	460	(000773) 28.05 (000780) 28.10
(000788)	28.14	481	
(000789)	28.18	500	(000757) 28.08 (000788) 28.13
(000800)	28.22		(000804) 30.01
(000804)	30.01	502	
(000810)	30.04	503	
(000835)	30.21	57	
(000837)	30.23	58	(000834) 30.05
(000838)	30.24	504	(000835) 30.03

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE BUCKET

(000847)	33.01	BUCKET	(000785) 28.10-X
(000877)	33.02	10	(000875) 33.01 (000875) 33.01
(000880)	33.04		(000881) 35.05
(000881)	33.05	12	
(000884)	33.07	20	(000875) 33.01 (000875) 33.01 (000875) 33.01 (000875) 33.01
(000885)	33.08	30	
(000891)	33.11	100	(000885) 33.08
(000892)	33.12		(000891) 34.10

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CARD 10	PAGE/SEN	NAME	REFERENCES	SOURCE SEQUENCE NO. AND PAGE/SEN						
(000001)	33.14	100	(000004)	33.13						
(000002)	33.15	110	(000004)	33.13						
(000007)	33.16	114								
(000008)	33.17	116								
(000003)	34.01	122	(000001)	33.14						
(000004)	34.02	124								
(000005)	34.03	126								
(000006)	34.04	100	(000001)	33.14	(000006)	33.16	(000007)	33.16	(000008)	33.17
			(000004)	34.02					(000009)	34.01
(000010)	34.05	100								
(000011)	34.07	100								
(000012)	34.08	170	(000006)	34.05						
(000016)	34.09	300	(000010)	34.05						
(000021)	34.10	400	(000017)	34.12						

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE FIELDS

(000030)	37.01	FIELDS	(000700)	38.00-1
(000031)	37.02		(000032)	37.03
(000032)	37.03	10		
(000037)	37.05		(000073)	37.06
(000073)	37.06	50		
(000077)	37.11		(000080)	37.12
(000080)	37.12	52		
(000082)	37.14		(000083)	37.16
(000085)	37.16	54		
(000086)	37.16		(000088)	37.20
(000089)	37.20	70		
(000094)	37.23		(000095)	37.24
(000096)	37.24	72		
(000098)	37.26		(001001)	37.27
(001001)	37.27	80		
(001003)	37.28		(001010)	38.01
(001004)	37.28		(001000)	37.28
(001005)	37.28	800		
(001010)	38.01	800		
(001012)	38.03		(001016)	38.05
(001016)	38.05	700		
(001021)	38.06		(001027)	38.11
(001027)	38.11	800		
(001030)	38.13	80		
(001040)	38.17	84	(001050)	38.12

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE FIELDS

(001040)	41.01	770403	(000700)	38.07-1			
(001050)	41.05	2					
(001055)	41.07	3					
(001060)	41.09	4	(001065)	41.05			
(001069)	41.09		(001081)	41.10			
(001091)	41.10	5					
(001094)	41.12	100	(001098)	41.04	(001097)	41.07	
(001099)	41.13	102					
(001100)	41.16	103					
(001106)	41.16	120	(001097)	41.14			
(001108)	41.16	123					
(001109)	41.20	124	(001100)	41.17			
(001117)	41.23		(001120)	41.24			
(001120)	41.24	125					
(001125)	41.25	200	(001094)	41.12	(001098)	41.15	
(001126)	41.27	203				(001100)	41.16
(001128)	42.01	205					
(001130)	42.03		(001130)	42.04			

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CHART NO	PAGE/BOX	NAME	REFERENCES (SOURCE SEQUENCE NO. AND PAGE/BOX)		
(001130)	42.04	204			
(001137)	42.05	200	(001123)	41.05	(001127) 41.00
(001142)	42.06		(001145)	42.00	
(001146)	42.09	401			
(001148)	42.12		(001151)	42.13	
(001151)	42.13	402			
(001154)	42.16		(001157)	42.17	
(001157)	42.17	403			
(001160)	42.19		(001162)	42.21	
(001162)	42.21	500			

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE MATL/1

(001171)	45.01	MATL/1	(001405)	53.14-X	
(001191)	45.01	100			
(001192)	45.02		(001193)	45.03	
(001193)	45.03	101			
(001195)	45.04	102			
(001197)	45.05		(001199)	45.06	
(001199)	45.06	103			
(001200)	45.08	31			
(001201)	45.09	32			
(001207)	45.10	104	(001199)	45.07	
(001209)	45.11		(001211)	45.14	
(001210)	45.13	107			
(001211)	45.14	110			
(001217)	45.19	108	(001200)	45.12	
(001219)	45.22	109	(001210)	45.13	(001216) 45.16
(001221)	45.24		(001222)	45.25	
(001222)	45.25	121			
(001225)	45.26		(001226)	45.28	
(001229)	45.30	122			
(001230)	45.31	130	(001230)	45.00	
(001230)	45.32	137	(001235)	45.18	
(001241)	45.35	131			
(001242)	45.37	132	(001244)	45.35	
(001244)	45.39	133			
(001245)	45.40	134	(001243)	45.38	
(001247)	45.42	135			
(001248)	45.43	136	(001246)	45.41	
(001253)	45.51	140			
(001255)	45.53		(001256)	45.54	
(001256)	45.54	141			
(001259)	45.59	142	(001302)	45.25	
(001260)	45.57	143			
(001260)	45.58		(001262)	45.26	
(001273)	45.60	144			
(001277)	45.11	145			
(001281)	45.14		(001284)	45.16	
(001284)	45.16	146			
(001287)	45.17	147			
(001288)	45.18	148			
(001289)	45.19	149	(001287)	45.17	
(001292)	45.20	150	(001290)	45.19	
(001295)	45.22	151			
(001300)	45.24		(001301)	45.25	
(001301)	45.25	152			
(001305)	45.26	153	(001295)	45.21	
(001311)	45.27	155			

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE MATL/2

(001319)	45.01	MATL/2	(001407)	54.01-X	
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CARD NO      PAGE/CH      NAME      REFERENCES (SOURCE SEQUENCE NO. AND PAGE/CH)

(00124)	40.02	20	(001230)	40.01
(001240)	40.04	20	(001230)	40.01
(001250)	40.05	40	(001230)	40.01
(001251)	40.05	100	(001247)	40.03
(001254)	40.10	107	(001240)	40.05
(001270)	40.14	120		
(001271)	40.15	121		
(001281)	40.20	203		
(001282)	40.22		(001280)	40.25
(001283)	40.25	204		
(001287)	40.25	205		
(001288)	40.25		(001282)	40.31
(001289)	40.31	207		
(001290)	40.32	190		

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE MEMRI

(001404)	02.01	MEMRI	(001424)	3.01-X
(001420)	02.02		(001427)	04.17
(001425)	02.03		(001428)	04.05
(001440)	02.04	10		
(001444)	02.07		(001443)	02.05
(001445)	02.05	20	(001430)	02.05
(001446)	02.05	22		
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(001458)	02.20	22		
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(001498)	04.02	210	(001490)	02.01
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CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE M100M

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(001632)	58.20	600	(001581)	57.15	(001629) 58.14

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE NAME

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(001711)	62.01	20	(001707)	61.12	
(001713)	62.02	22	(001711)	62.01	
(001717)	63.01	20	(001711)	62.01	
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(001737)	63.15	130	(001735)	63.14	
(001738)	63.16	132			
(001739)	63.17	135			
(001742)	63.18	137			
(001744)	63.20	140	(001737)	63.15	
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(001746)	63.22	142			
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CHART TITLE - INTRODUCTORY COMMENTS

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CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

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(000017) 74.13 40	(000000) 74.10		
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CHART TITLE - INTRODUCTORY COMMENTS

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CHART TITLE - INTRODUCTORY COMMENTS

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CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SUBROUTINE SPAL

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CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

CHART TITLE - SIGNATURE SPINE

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CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

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CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - INTRODUCTORY COMMENTS

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CHART TITLE - NON-PROCEDURAL STATEMENTS

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(000100)	4.12	UNRECOGNIZED SYMBOL
(001470)	00.00	UNDEF INED - 'LEADS' EXTERNAL REFERENCE
(001042)	04.12	UNDEF INED - 'WRITING' EXTERNAL REFERENCE
(001704)	04.00	UNDEF INED - 'LEADS' EXTERNAL REFERENCE
(001000)	74.04	UNDEF INED - 'LEADS' EXTERNAL REFERENCE
(000004)	77.14	UNDEF INED - 'LEADS' EXTERNAL REFERENCE

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PROGRAM FLOW CHARTS  
OF  
AIR INDUCTION SYSTEM MODULE

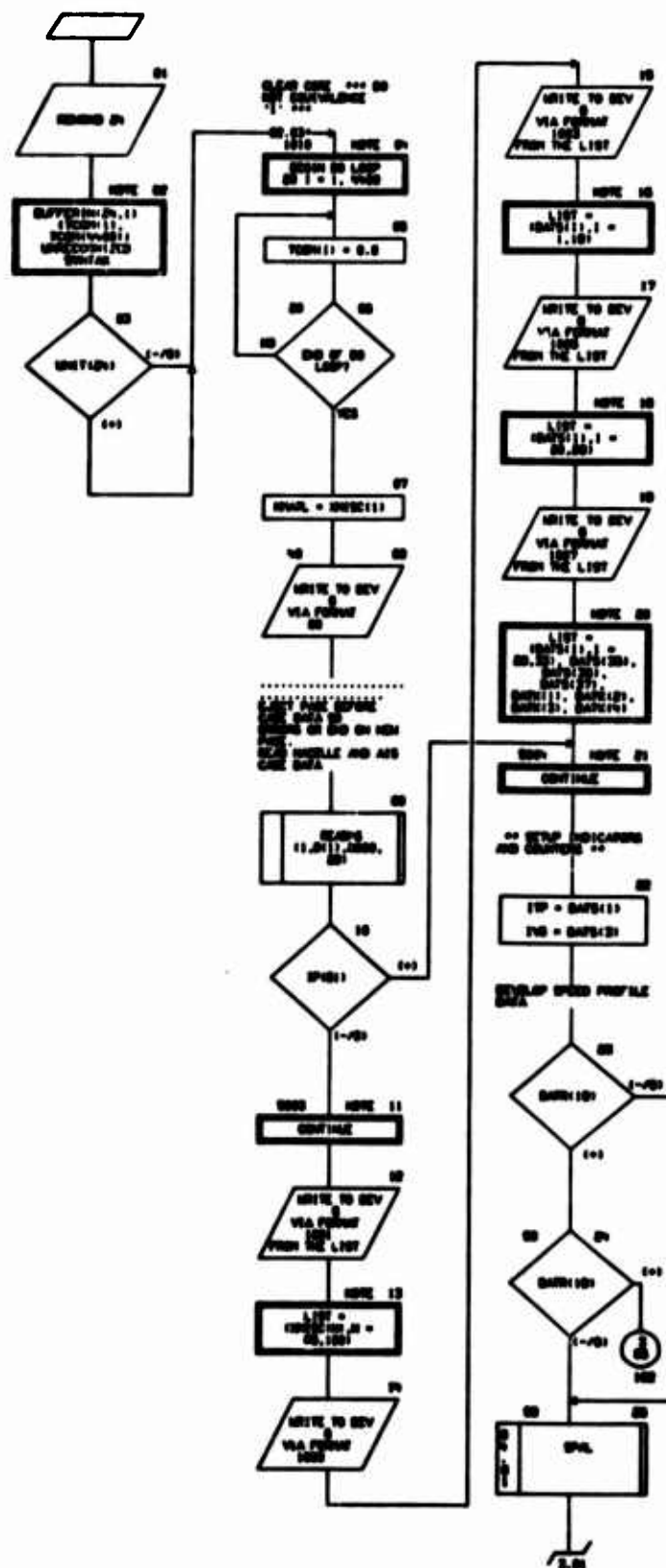
08/08/74

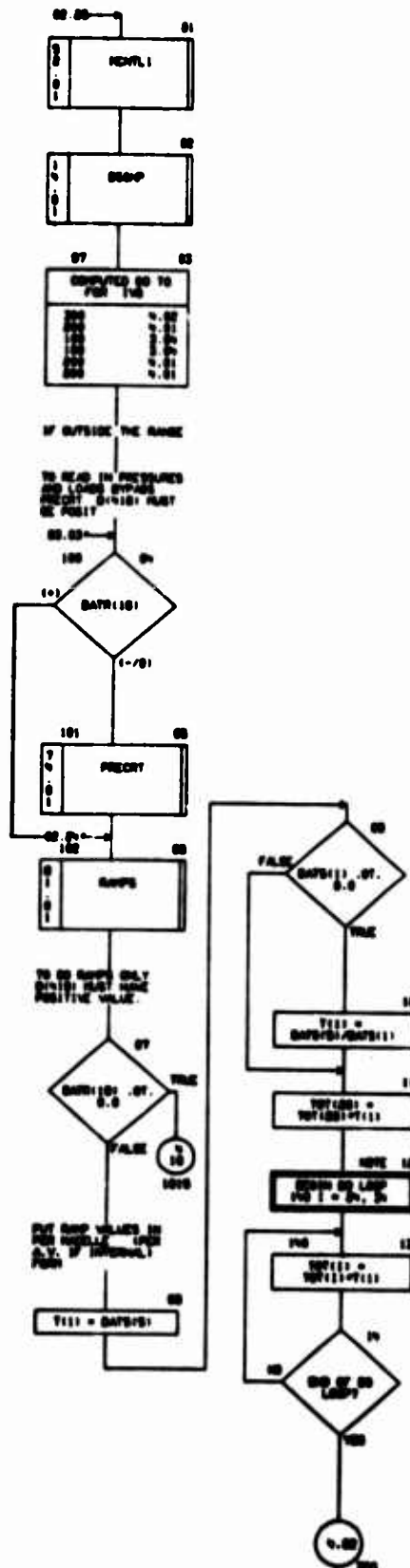
AIRPLANE CHART SET - 0000 AIR INJECTION SYSTEM MANUAL PAGE 01

CHART TITLE - INJECTION SYSTEM

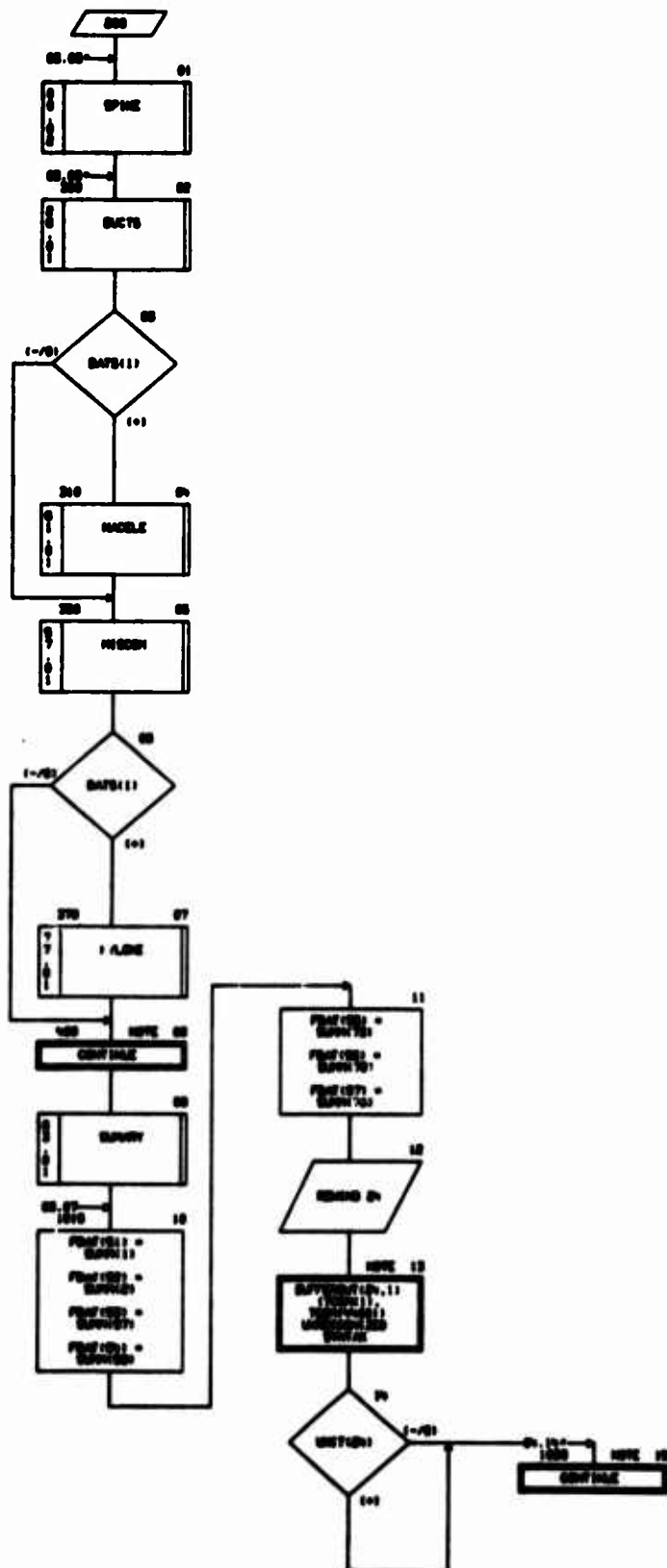
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\*\* AIR INJECTION SYSTEM, MANUAL AND ENGINE SECTION  
CONTROL, ROUTINE \*\*  
WRITTEN 20 MARCH 1972

**CHART TITLE - PROCEDURES**



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PROGRAM ALIGN
OPEN TOWH4400)
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OPEN /FIRN/ /F(00)
OPEN /BAT/ /BAT(00)
DIMENSION SUPN(200)
DIMENSION D(2000),T(2000),SC(100),JD(200)
DIMENSION WB(200),RW(20)
DIMENSION BATS(40)
DIMENSION TOT(100)
DIMENSION BATH(120),SR(50)
DIMENSION BARK(10)
DIMENSION F(200)
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SUBWLDCD (D(40),BATH(1)),D(40),SR(1))
SUBWLDCD (D(27),BARK(1))
SUBWLDCD (D(77),F(1))
SUBWLDCD (T(10),WB(1))
SUBWLDCD (T(120),WB(1)),(WB(200),RW(1))
SUBWLDCD (D(100),JPAE)
SUBWLDCD (D(100),JPAFL)
SUBWLDCD (D(01),JF1),D(02),JF2),D(03),JF3),D(04),JF4)
SUBWLDCD (D(111),JTP),D(112),JVB)
SUBWLDCD (D(113),JPT)
FORMAT(M)
FORMAT(1M,BK,2M** ALIGN - (F(01) **/BEN,E /BEN,BAL)
FORMAT (10, 40, 20AIR INJECTION SYSTEM DATA)
FORMAT(1M,10NUMBER OF NACELLES, TAB, F0.1 /
  1M, 10BYPASS RATIO, TAB, F10.2 /
  07N,30M1.-FIXED SUCT 2.-FIXED SPINE) /
  1M,VEHICLE TYPE (0.-00RIZ. RAP 4.-VERT. RAP 3, TAB, F0.1 /
  07N,30M5.-TRAIL SPINE 0.-OPN40.SPINE) /
  1M,CAPTURE AREA PER INLET, TAB, F10.2 /
  1M,20NUMBER OF NACELS PER AIR VEHICLE, TAB, F0.1 /
  1M,40M DISTANCE OF THROAT FROM L.S. OF OAL OR LIP, TAB, F11.3 /
  1M,10NUMBER OF ENGINES, TAB, F0.1 /
  1M,10THROAT PER ENGINE, TAB, F10.2 /
  1M,10THROAT PER ENGINE, TAB, F11.3 /
  1M,10LENGTH OF ENGINE, TAB, F11.3 /
  1M,10DIAMETER OF ENGINE, TAB, F11.3 /
  1M,20ENGINE C.O.. DISTANCE HT OF FACE, TAB, F11.3 /
  1M,20M AT OAL OR LIP, SET 1, TAB, F11.3 /
  1M,20M AT ENGINE FACE, SET 1, TAB, F11.3 /
  1M,20M AT ENGINE FACE, SET 1, TAB, F11.3 /
  1M,20M AT OAL OR LIP, SET 2, TAB, F11.3 /
  1M,20M AT ENGINE FACE, SET 2, TAB, F11.3 /
  1M,20M AT ENGINE FACE, SET 2, TAB, F11.3 )
FORMAT (1M, 20ENGINE DEEP OF PYLEN, TAB, F10.2 /
  1M, 40VEHICLE TYPE (0.-VERT. 1.-00RIZ) 10-PYLEN,TAB, F0.1 /
  1M, 20ENGINE CHRD OF INBOARD PYLEN, TAB, F10.2 /
  1M, 20SPAN OF INBOARD PYLEN, TAB, F10.2 /
  1M, 20ENGINE CHRD OF OUTBOARD PYLEN, TAB, F10.2 /
  1M, 20SPAN OF OUTBOARD PYLEN, TAB, F10.2 /
  1M, 20PYLEN THICKNESS TO CHRD RATIO, TAB, F11.3 /
  1M, 40HORIZONTAL INLET AREA PER NACELLE OR AIR VEHICLE,
    TAB, F11.3 /
  1M, 40SUCT BYPASS AREA PER NACELLE OR AIR VEHICLE,TAB, F11.3 )
FORMAT (1M, 20AREA OF MISCELLANEOUS BORG, TAB, F11.3 /
  1M, 20HORIZONTAL INBOARD R(0.-00,1.-YES-CALC,AT 1.-00)RD AREA,
    TAB, F11.3 /

```

```

MEM, SEMIEMPIRICAL ALPHEI FOR DUCTS, TDB, F0.1 /
MEM, SEMIEMPIRICAL ALPHEI FOR RAYS, TDB, F0.1 /
MEM, SEMIEMPIRICAL ALPHEI FOR MODELS, TDB, F0.1 /
MEM, CURRENT GEME (1.-1000.0-200000000. ... 9.-1000.),
    TDB, F0.1 /
MEM, SPLITTING ACCELERATION, TDB, F11.3 /
MEM, SEMIEMPIRICAL LAMB FACTOR, TDB, F10.2 /
MEM, MEM FACTORS...DUCTS-F0.2.IN, THERMOS-F0.2.IN, THERMOS-
    F0.2.IN, HOLLOWBURNED-F0.2 )

```

**COURT TITLE - INTERIMATORY ORDERS**

AUTOFLEX CHART SET - SHEEP AIR INDUCTION SYSTEM MODULE PAGE 07

=====

**BLANKETING OUTGO**

=====

00.00 — 01  
 WRITTEN BY: MARCH 1972  
 BY: J. L. B.

### TYPE INDICATORS AND

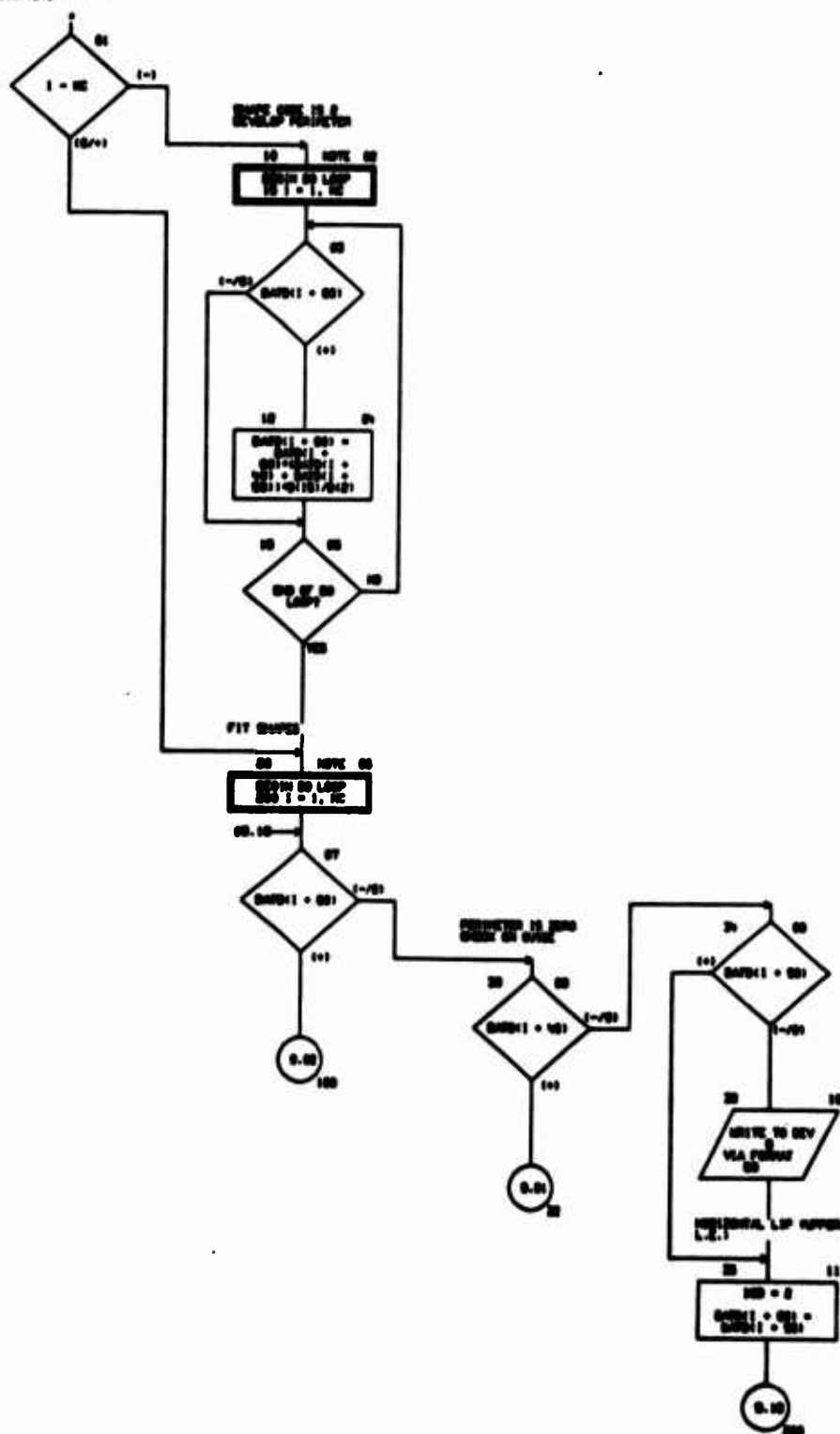
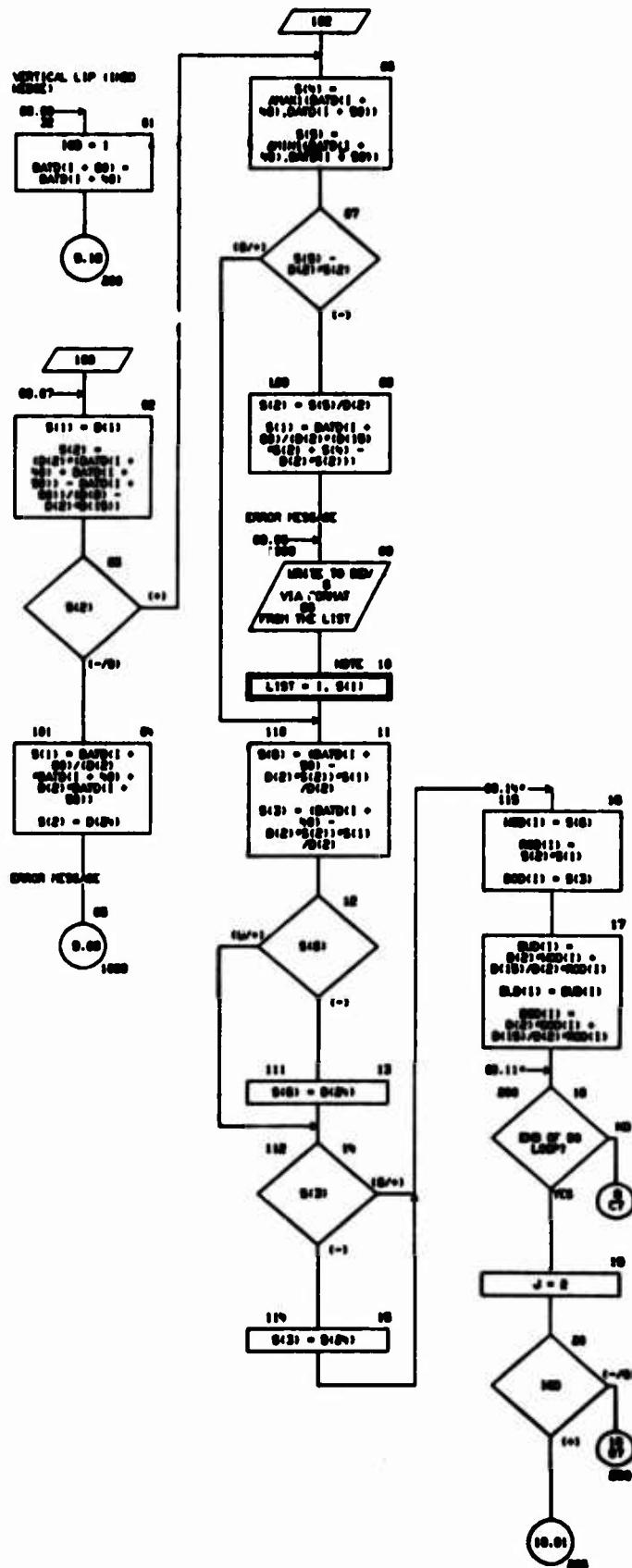
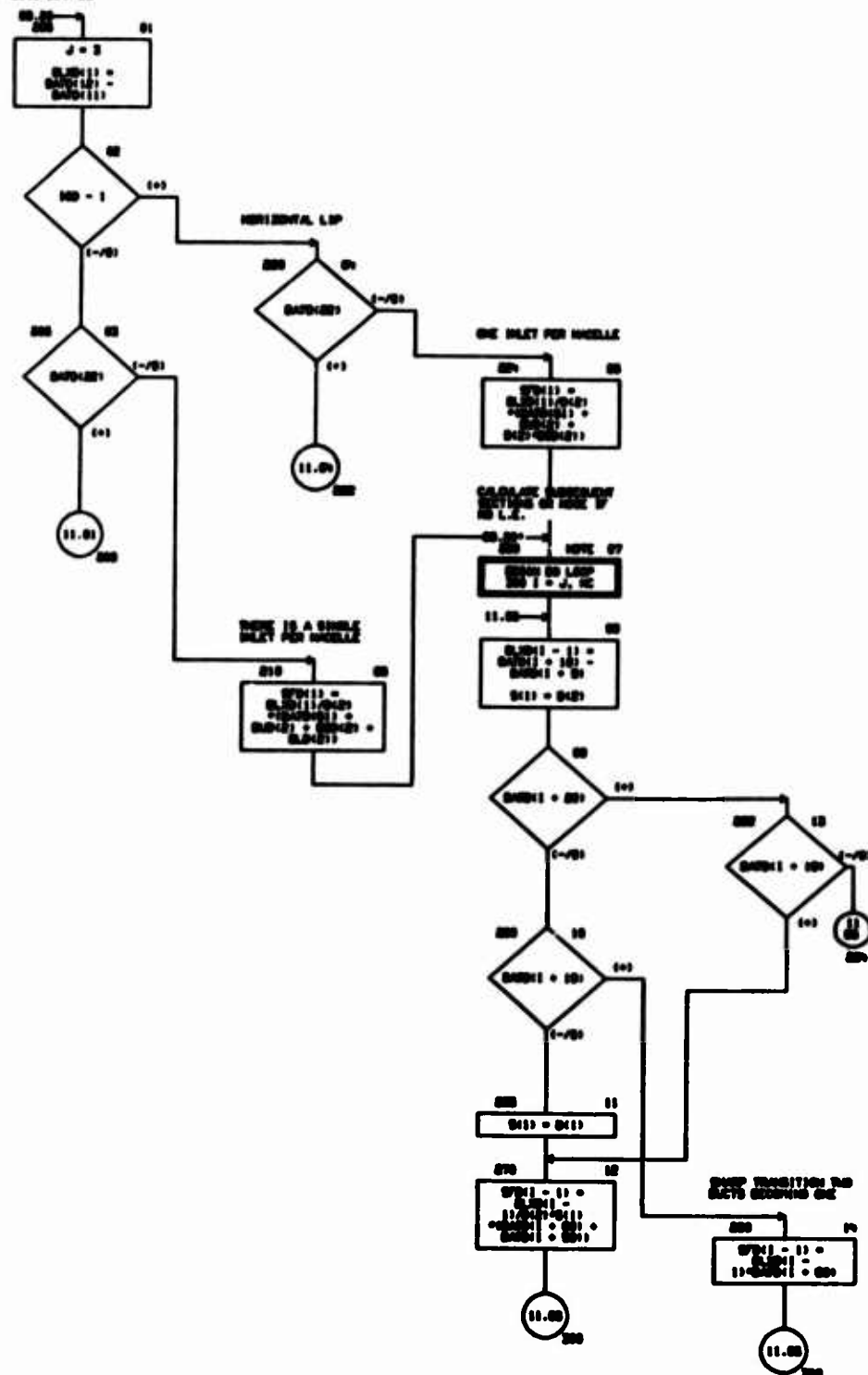


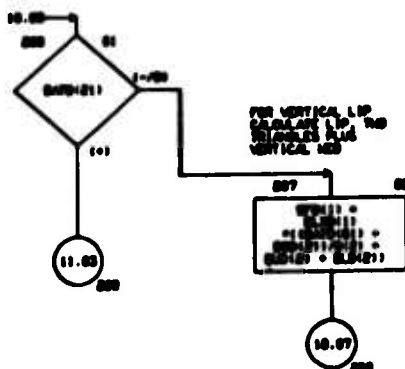
CHART TITLE - SUBROUTINE 04200



**CALCULATE LEADING  
EDGE SURFACE**



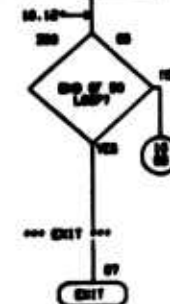
SECOND OF IS EVERY  
THIRD ONE WERE AN  
THE INLET FOR  
NACELLE



11-01  
SFB(1) •  
SLB(1) = SFB(1)  
• SSB(2) •  
SLB(2) • SLB(2)

[illegible]

10-12  
200



## GARY TITLE - NON-PRESSURE STATEMENTS

```

GIVEN T0000001
DIMENSION S(2000), T(2000), DC(100), MD(200)
DIMENSION S(2000)
DIMENSION S(100)
DIMENSION MD(10), MD(10), MD(10), MD(10), MD(10), MD(10)
DIMENSION S(10), S(10)
EQUIVALENCE MD(1), T000(1), T(1), T000(200), DC(1), T000(10),
MD(1), T000(200)
EQUIVALENCE MD(20), S(200)
EQUIVALENCE T(1), S(1)
EQUIVALENCE T(10), MD(1), T(20), MD(1), T(20), MD(1),
T(1), MD(1), T(20), MD(1), T(20), MD(1)
EQUIVALENCE T(10), MD(1), T(20), MD(1)
EQUIVALENCE MD(10), T, MD(10), J
EQUIVALENCE MD(10), MD(10), MD(10), MD(10), MD(10), MD(10)
00 FORMAT (NUMBERED FROM SETS IN AIR INDUCTION SYSTEM / 300,
CONJECT LIP GEOMETRY DATA )
05 FORMAT (NUMBERED FROM SETS IN AIR INDUCTION SYSTEM / 100,
THESE, 112, MD IS RECTANGLE ON RELATED RECT., CORRECTION IS
170.3 )

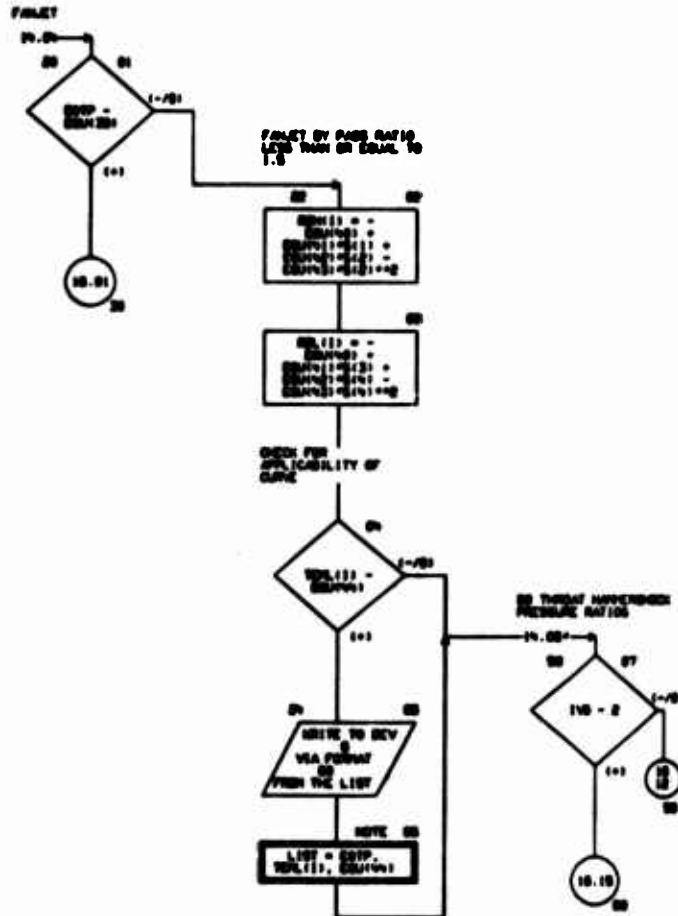
```

SHORT TITLE - INTRODUCTORY COMMENTS

\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*  
\*\*\*\*\*

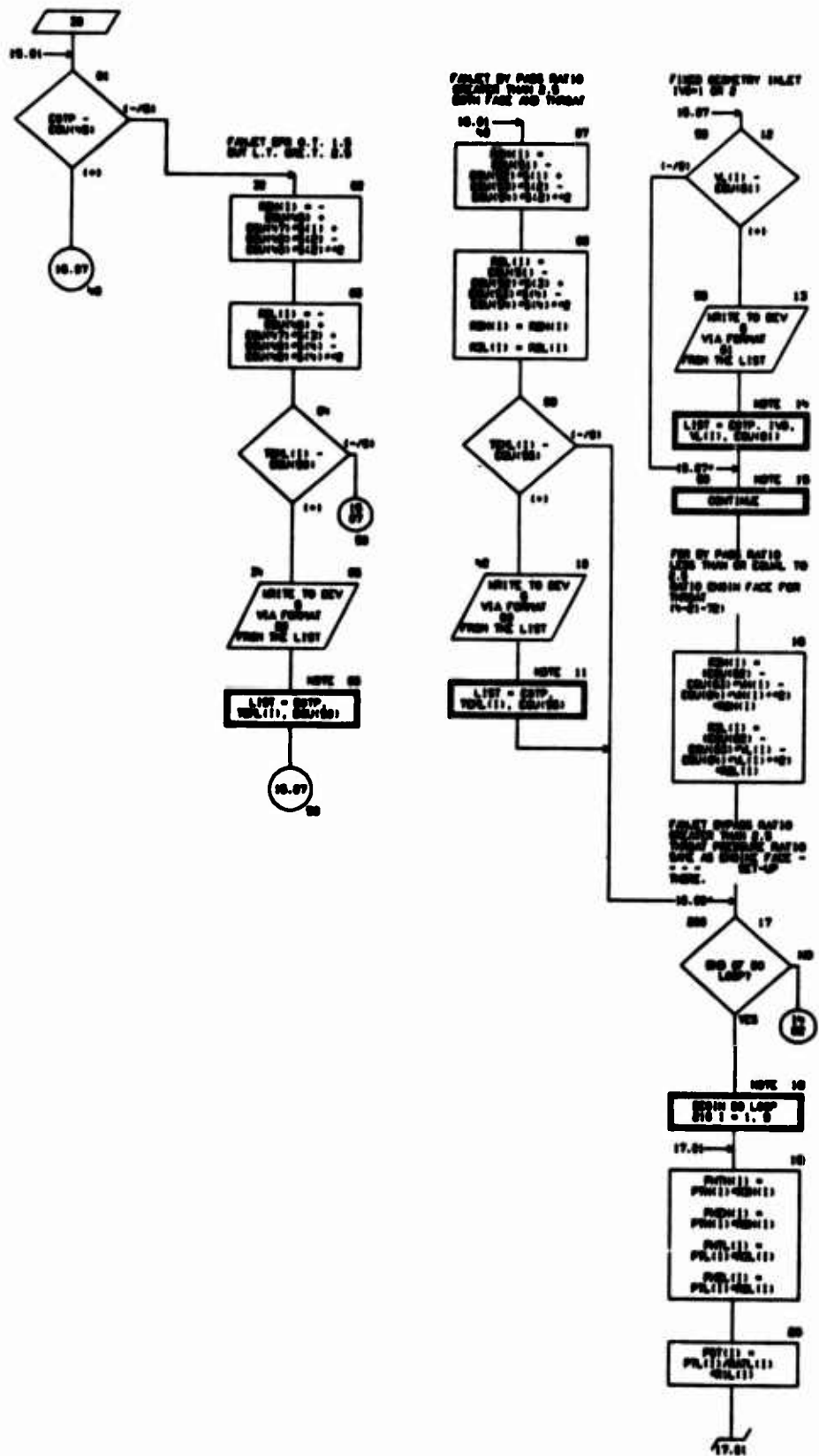
[illegible]

CHART TITLE - SUBROUTINE 000P



PALETT BY PALE RAY 10  
SHADE FROM 2.0  
DOWN FACE AND THROAT

**FINED GEOMETRY INLET**  
INLET AS A



[illegible]

[illegible]

CHART TITLE - INTRODUCTORY COMMENTS

#####  
#####  
#####

GWT TITLE - SUBROUTINE SUCF7M

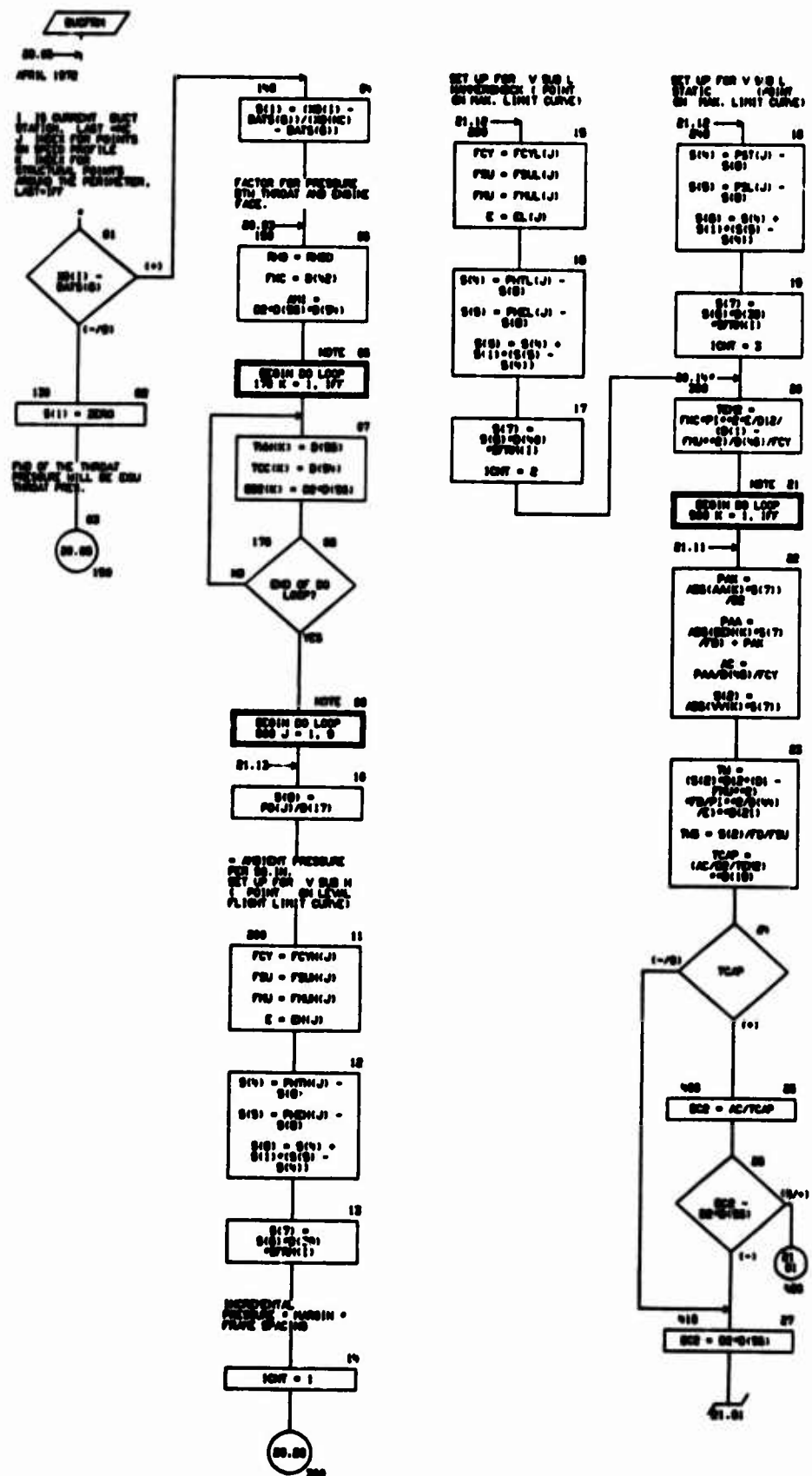
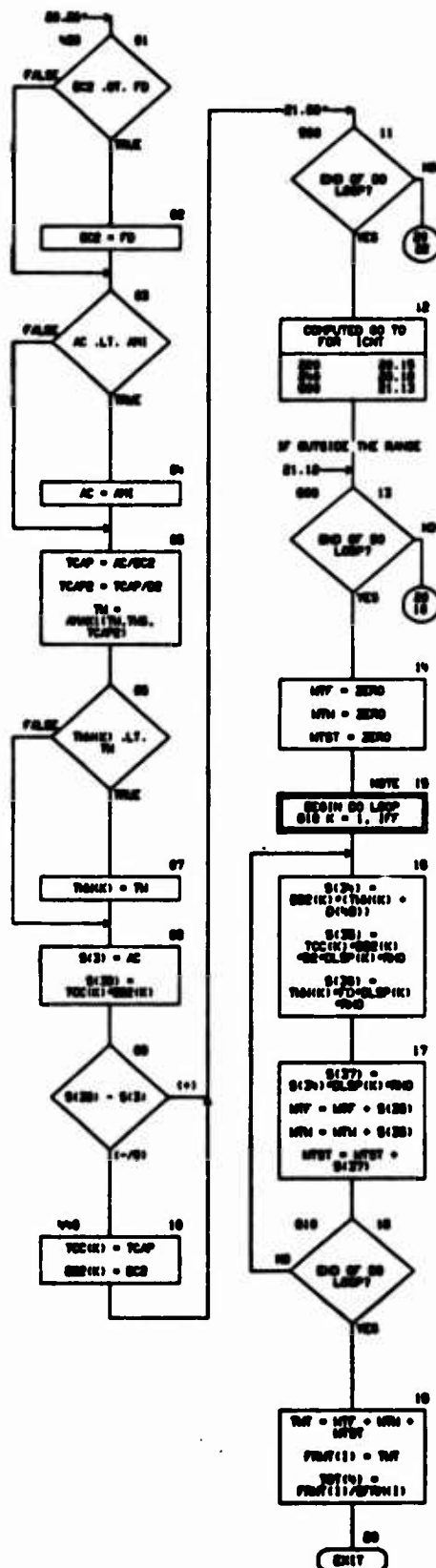


CHART TITLE - SUBROUTINE 0400P



## DURT 117.2 - NON-PROCEDURAL STATEMENTS

```

GIVEN TORN400)
DEFINITION (H2000),T1000),C1100),J01000)
DEFINITION S1000)
DEFINITION TOT100),SPW10),FMT10)
DEFINITION ALD100), BLP100), SDH00), VV00),
AA00), T0000), TCC100), S00100)
DEFINITION SATS100), SATD100), SD100)
DEFINITION PCW100), PCV100), FPM100), FDL100),
FPM100), FPL100), SM100), EL100)
DEFINITION PD100), PL100), PWH100), PDK100),
PML100), PHL100), PST100)
DEFINITION (H11),TORN11),T111),TORN0011),C11),TORN41011),
SD11),TORN10011)
DEFINITION (H11),S11), (H12),S01),
(H13),S01), (H14),S01), (H15),S01),
(H16),S01), (H17),S01), (H18),S01),
(H19),S01), (H101),S101), (H111),S111),
(H112),S101), (H113),S11), (H114),S00)
DEFINITION (H1001),SATD111), (H101),SATD111),
(SATD111),SD111)
DEFINITION (T11),S111), (T1001),ALD111)
DEFINITION (H141),F01), (H147),F01),
(H148),F01), (H149),F01), (H151),C1),
(H152),J01), (H153),F01), (H154),J01),
(H155),T001), (H156),F01), (H157),F01),
(H158),AC1), (H159),T01), (H160),T01),
(H161),T01), (H162),S01), (H163),T01),
(H164),J01), (H165),J01), (H166),J01),
(H167),T01)
DEFINITION ALD11),BLP111), ALD101),SDH111),
ALD101),VV111), ALD101),AA111)
DEFINITION (T101),TOT111),T1711),SPW111),T1741),FMT111)
DEFINITION (T101),PD111), (T101),PL111),
(T101),PWH111), (T101),PDK111), (T101),PML111),
(T101),PDL111), (T101),PST111), (T101),PCW111),
(T101),PCV111), (T101),FPM111), (T101),FDL111),
(T101),FPM111), (T101),FPL111), (T101),SM111),
(T101),EL111), (T101),J01)
DEFINITION (T1001),T001), (T101),TCC111),
(T101),S0011)
DEFINITION (H101),S1), (H102),S1),
(H103),S1), (H104),S1), (H105),S1),
DEFINITION (H101),J01)

```

03/05/74

AIR/FLIN CHART SET - SHEEP AIR INDUCTION SYSTEM MODULE PAGE 03

CHART TITLE - INTRODUCTORY COMMENTS

\*\*\*\*\*  
SUBROUTINE SUBPH.  
\*\*\*\*\*



**SETUP POWERBOOK AT**



GARY TITLE - NEW-PRODUCED STAMENTS

```

OPEN TOWNH001
DIMENSION D(2000),T(2000),EC(100),JH(200)
DIMENSION DSH(200)
DIMENSION DAFS(40),DAFB(40),JH(10)
DIMENSION S(100),TOT(100)
DIMENSION PTM(10),PTL(10),JH(10),JL(10),PTM(10),PTL(10)
DIMENSION PO(10),PEL(10),PMM(10),PDM(10),PML(10),PEL(10),
POT(10)
DIMENSION STW(10),TC(10),TL(10)
EQUIVALENCE (D(1),TCM(1)),(T(1),TCM(2001)),(EC(1),TCM(4001)),
(JH(1),TCM(6001))
EQUIVALENCE (D(51),DSH(1))
EQUIVALENCE (D(52),DAFS(1)),(D(53),DAFB(1)),(D(54),JH(1))
EQUIVALENCE (T(1),S(1)),(T(50),TOT(1))
EQUIVALENCE (T(101),PTM(1)),(T(102),PTL(1)),(T(103),JH(1)),
(T(104),JL(1)),(T(105),PTM(1)),(T(106),PTL(1)),(T(107),JH(1)),
EQUIVALENCE (T(108),PO(1)),(T(109),PEL(1)),(T(110),PMM(1)),
(T(111),PDM(1)),(T(112),PML(1)),(T(113),PEL(1)),
(T(114),POT(1))
EQUIVALENCE (T(115),STW(1)),(T(116),TC(1)),(T(117),TL(1))
EQUIVALENCE (JH(101),J), (JH(102),J), (JH(103),J)
EQUIVALENCE (JH(104),JC)
EQUIVALENCE (JH(105),MPL)

```

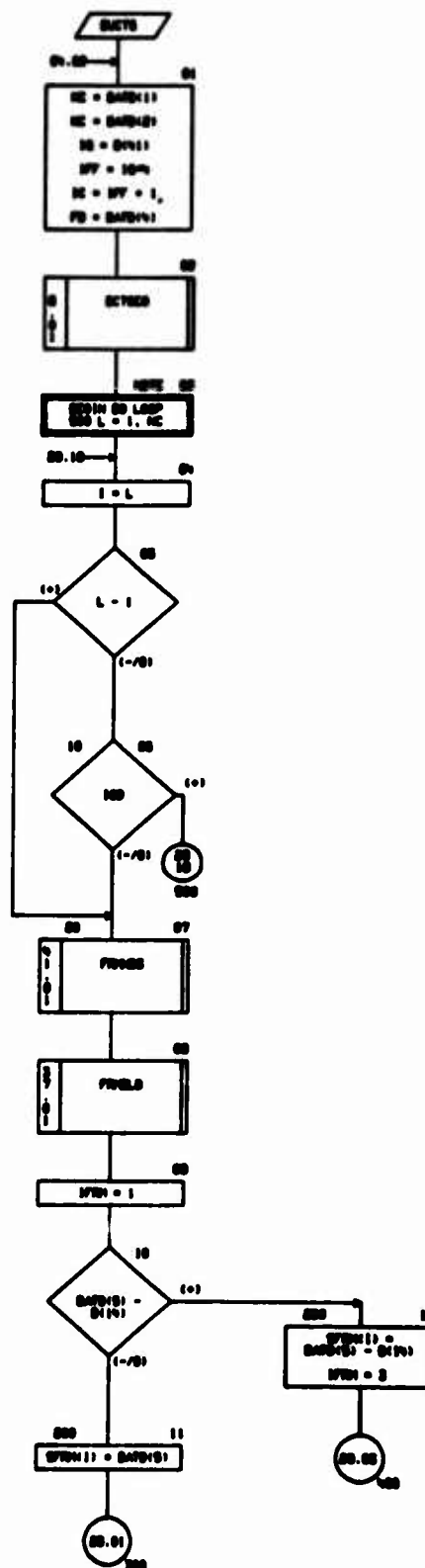
08/05/76

AUTOFLEX CHART SET - SHEEP AIR INDUCTION SYSTEM MANUAL PAGE 87

CHART TITLE - INTRODUCTORY COMMENTS

.....  
SUBROUTINE DUCTS  
.....

GUNNY TITLE - SUBROUTINE GUNTS

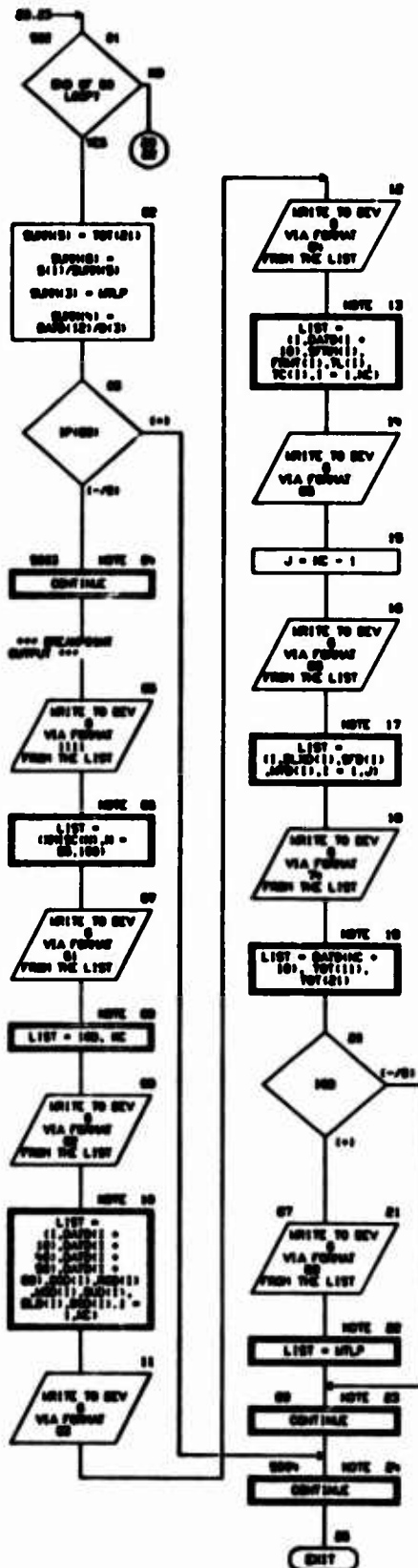


```

graph TD
    START([START]) --> D1{DATA(1) = 0?}
    D1 -- YES --> STOP1([STOP])
    D1 -- NO --> P1[SUM = SUM + DATA(1) * DATA(1)]
    P1 --> P2[COUNT = COUNT + 1]
    P2 --> D2{COUNT = 10?}
    D2 -- YES --> P3[AVERAGE = SUM / COUNT]
    P3 --> P4[PRINT AVERAGE]
    P4 --> STOP1
    D2 -- NO --> D1
  
```

PROGRAM 1  
SUM OF SQUARES

CHART TITLE - SCHEDULED DEFS





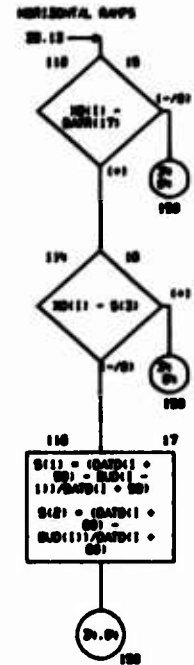
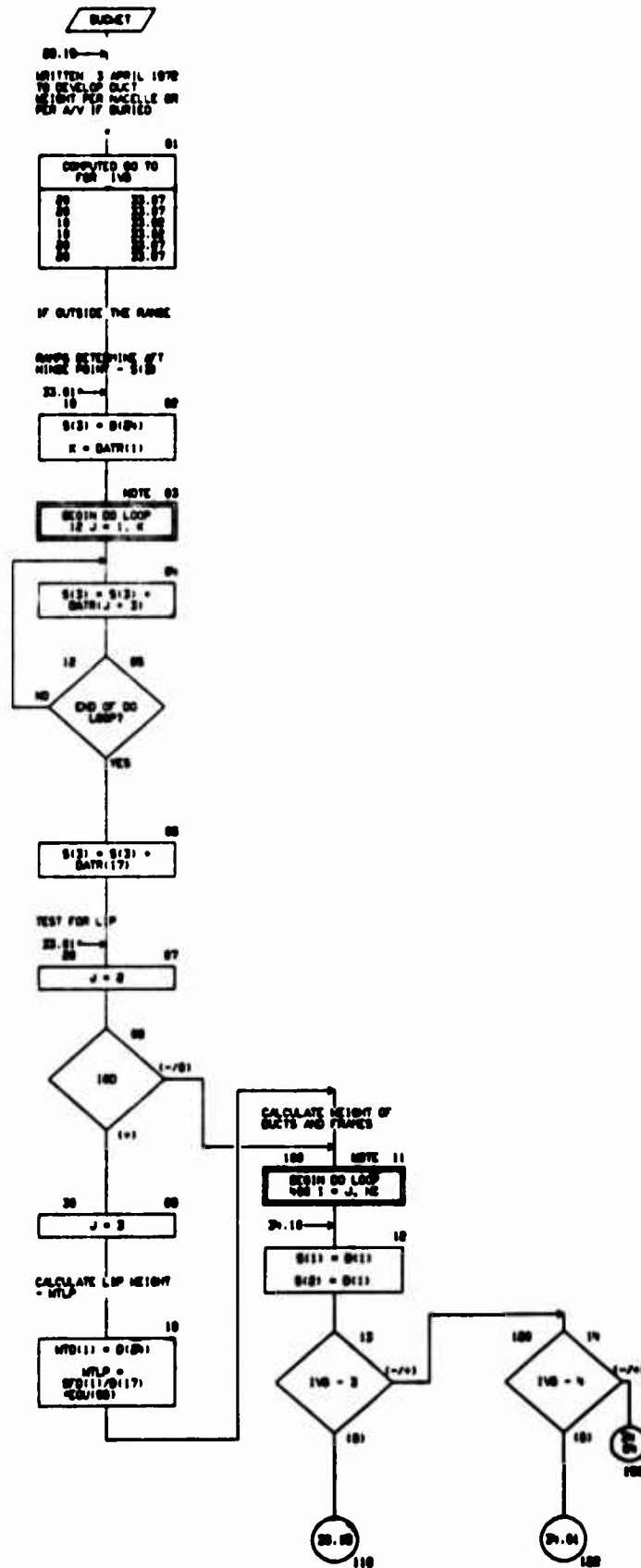
03/08/74

AUTOLIN COURT SET - SHEEP AIR INJECTION SYSTEM RELEASE PAGE 22

COURT FILE - INTERIMINARY COMMENTS

\*\*\*\*\*  
SUBROUTINE SUCKET  
\*\*\*\*\*

CHART TITLE - SUBROUTINE BUCKET



VERTICAL SWAPS - TEST  
PER LOCATION



CHART TITLE - NON-PROCEDURAL STATEMENTS

```

COMMON TCDW(400)
DIMENSION D(2000),T(2000),DC(100),ND(200)
DIMENSION DBU(200)
DIMENSION DADR(20),DATR(120),ND(10)
DIMENSION U(100),TOT(100)
DIMENSION BLJ(10),BBD(10),BLJD(10),SPD(10)
DIMENSION STW(10),TC(10),TL(10),FRAT(10)
DIMENSION MTD(10)
EQUIVALENCE (D(1),TCDW(1)),(T(1),TCDW(2001)),(DC(1),TCDW(4001)),
  (ND(1),TCDW(8001))
EQUIVALENCE (D(81),DBU(1))
EQUIVALENCE (D(82),DADR(1)),(D(40),DATR(1)),(D(40),DADR(1)),ND(1)
EQUIVALENCE (T(1),U(1)),(T(10),TOT(1))
EQUIVALENCE (TOT(2),MTD)
EQUIVALENCE (T(54),BLJ(1)),(T(55),BBD(1)),(T(57),BLJD(1)),
  (T(58),SPD(1))
EQUIVALENCE (T(59),MTD(1))
EQUIVALENCE (T(710),R(40))
EQUIVALENCE (T(71),STW(1)),(T(72),TC(1)),(T(73),TL(1)),
  (T(74),FRAT(1))
EQUIVALENCE (ND(101),I),(ND(102),J),(ND(103),K)
EQUIVALENCE (ND(112),IV),(ND(114),I00),(ND(115),NC)

```

**CHART TITLE - INTERVIEW CONTENTS**

#####  
SUBROUTINE FIVE0  
#####

CHART TITLE - SUBROUTINE FFIELD

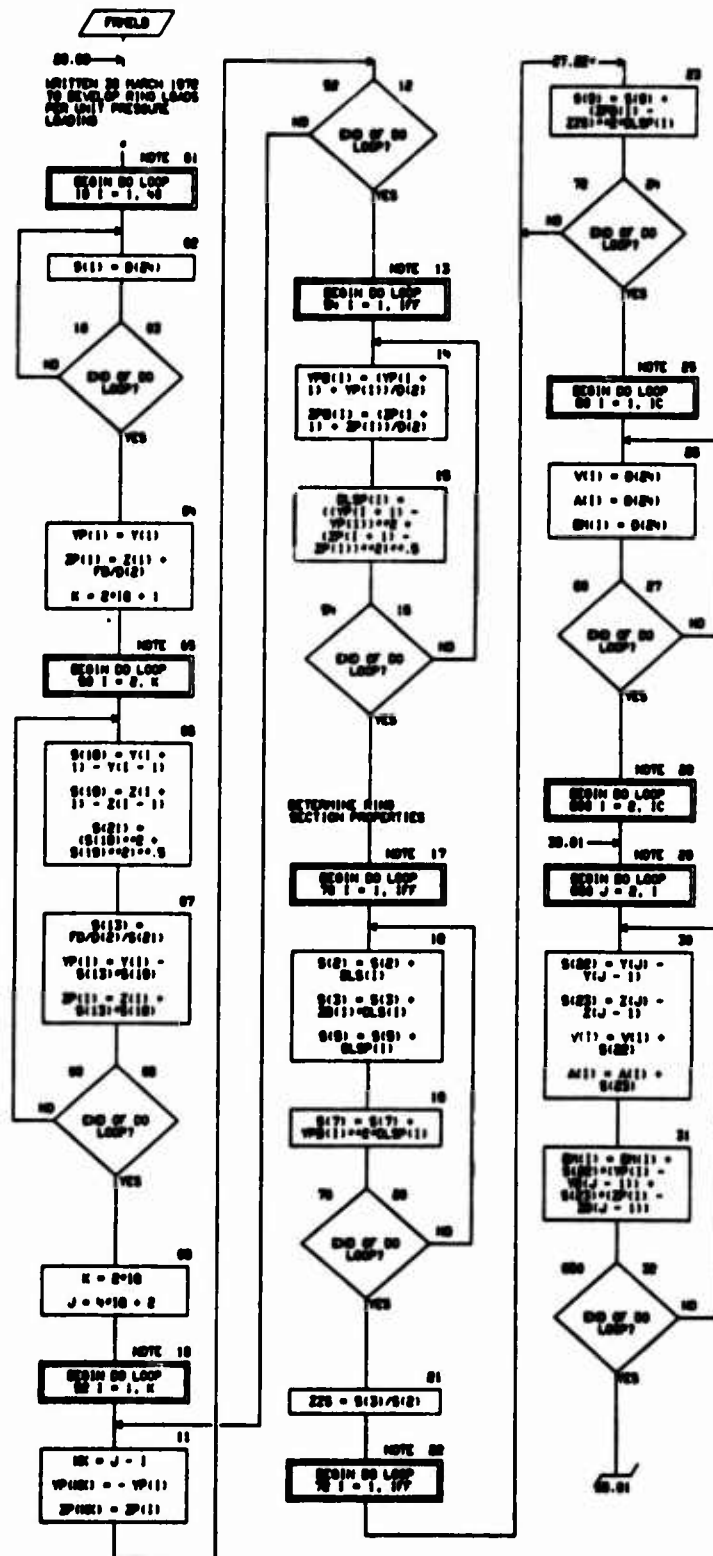




CHART TITLE - NON-PROCEDURAL STATEMENTS

```

OPEN TCDH400
OPEN /PRINT / P100
DIMENSION D(2000),T(2000),JC(100),NB(200)
DIMENSION S(100)
DIMENSION DLP(00),SDH(00),VW(00),AA(00)
DIMENSION VB(00),Z(00),LS(00),WP(00),SP(00)
DIMENSION Y(01),Z(01),WP(01),SP(01)
DIMENSION VI(01),AI(01),BH(01)
EQUIVALENCE (011),TCDH111),(T111),TCDH20011),(JC11),TCDH41011,
NB11),TCDH4011)
EQUIVALENCE (T111),S111)
EQUIVALENCE (S141),VB),(S142),Z21),(S143),WP),(S144),JD),
(S145),VD)
EQUIVALENCE (T1001),DLP111),(T1001),SDH11),(T1141),VW11),
(T1001),AA11)
EQUIVALENCE (T1201),VB11),(T1201),Z11),(T1201),LS11),
(T1441),WP11),(T1201),SP11)
EQUIVALENCE (T1001),V11),(T1001),Z11),(T1001),WP11),
(T1741),SP11)
EQUIVALENCE (T1001),V11),(T1001),AA11),(T1001),BH11)
EQUIVALENCE (NB100),J1,(NB100),K),(NB100),L1,
NB100),K1)
EQUIVALENCE (NB111),IPET)
EQUIVALENCE (NB110),I0),(NB110),IF1),(NB120),IC)
01 FORMAT(1H1,NB,2H** OBJECT FILE DATA ***,2X,
      2H** FIELDS - (P100) ** /AX,3SECTION,13,
      4H,154HIT RECORDS,2X,2HPS = ,F0.3,2X,4H0 = ,F0.3,2X,4H0 = ,
      F0.34X,10DUCT PERIMETER = ,F0.34X,10ORING PERIMETER = ,F0.3/2X,
      2HOUT/SEC,2X,1H7,2X,1H2,2X,2HPS,2X,2H0,2X,2HCLS,2X,2HPP,2X,2H0P,
      2H,2HPP,2H,2HPS,2H,4HCLSP)
02 FORMAT(10,10F10.3)

```

05/05/74

AIRFLOW CHART SET - DEEP AIR INJECTION SYSTEM MANUAL PAGE 40

CHART TITLE - INTRODUCTION CONTENTS

\*\*\*\*\*  
CONTENTS PAGE  
\*\*\*\*\*

**CHART TITLE - ALLEGATIONS**

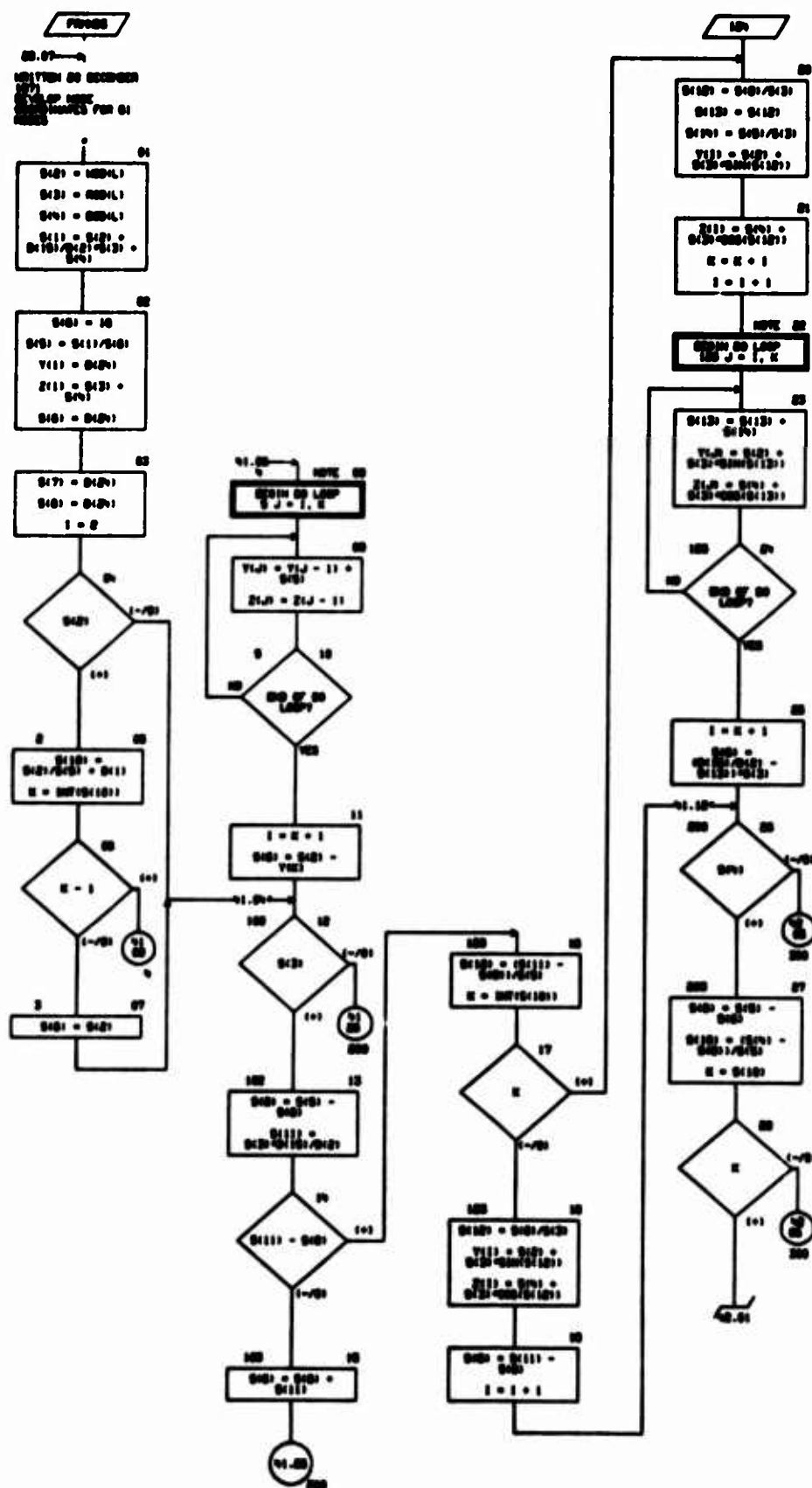


CHART TITLE - SUBROUTINE F7000

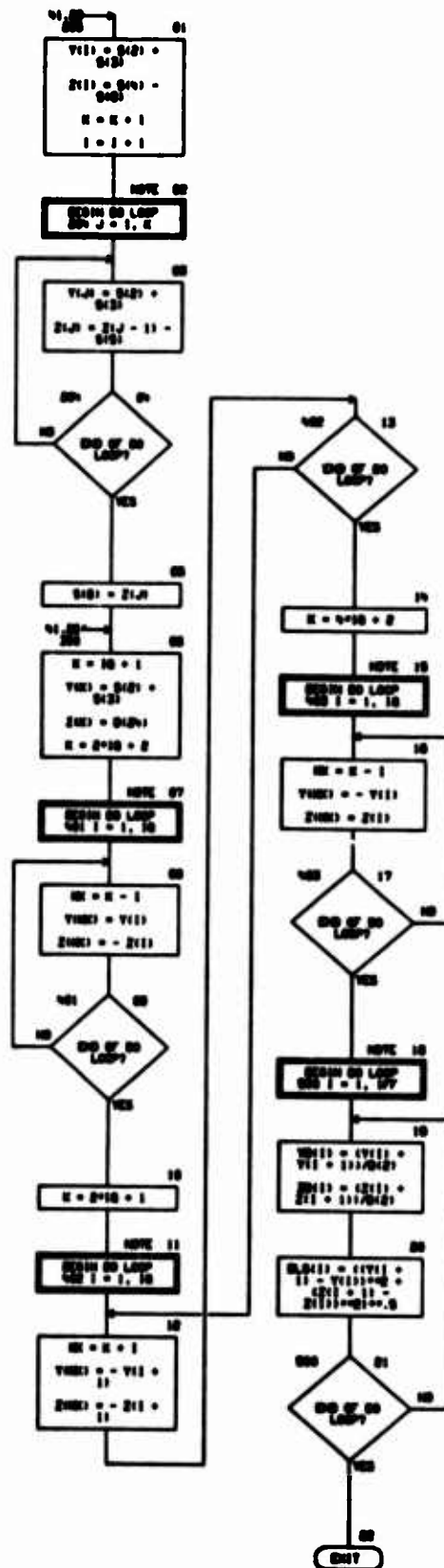


CHART TITLE - NEW FEDERAL STANDARDS

```

COMMON TCOM(100)
DIMENSION S(200),T(200),SC(100),JD(200)
DIMENSION S(100)
DIMENSION MD(10),MB(10),SD(10)
DIMENSION YD(00),ZD(00),SLD(00)
DIMENSION Y(01),Z(01)
DO 111,TCOM(11),T(11),TCOM(20011),SC(11),TCOM(1011),
  MD(11),TCOM(0011)
CONTINUE T(11),S(11)
DO 112,TCOM(11),MD(11),T(0011),SD(11),T(0011),SD(11)
CONTINUE T(1001),YD(11),T(1001),ZD(11),T(1001),SLD(11)
CONTINUE T(1001),Y(11),T(1001),Z(11)
CONTINUE MD(100),JD,MD(100),X1,MD(100),L1,
  MD(100),X1
CONTINUE MD(110),10,MD(110),177

```

02/25/74

AUTOFLEX CHART SET - BEEP AIR INJECTION SYSTEM MODEL PAGE 44

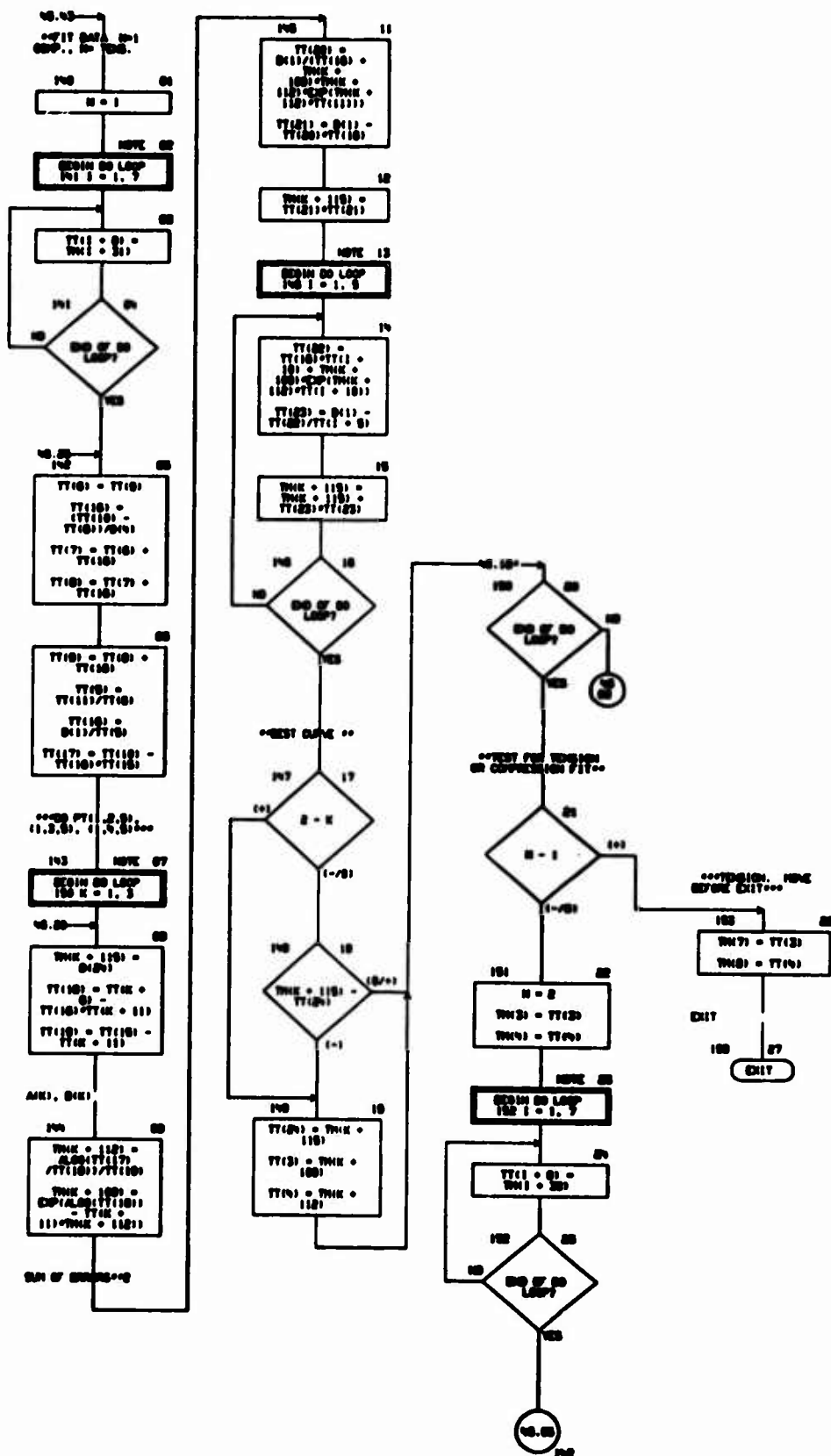
CHART TITLE - INTRODUCTORY COMMENTS

\*\*\*\*\*  
 SECRET//NOFORN  
 \*\*\*\*\*

**HAUS:**

\*\*REVISION--01-11-00  
 --ADD MAIL. PROP.  
 FILE. \*\*\*  
 REVISION -- 01-11-00  
 -- NEW LOGIC.  
 LINKAGE. NO PRINT ON  
 PAPER



**QUEST TITLE - SUBMITTING NAME**

## CHART TITLE - NON-PROCEDURAL STATEMENTS

```

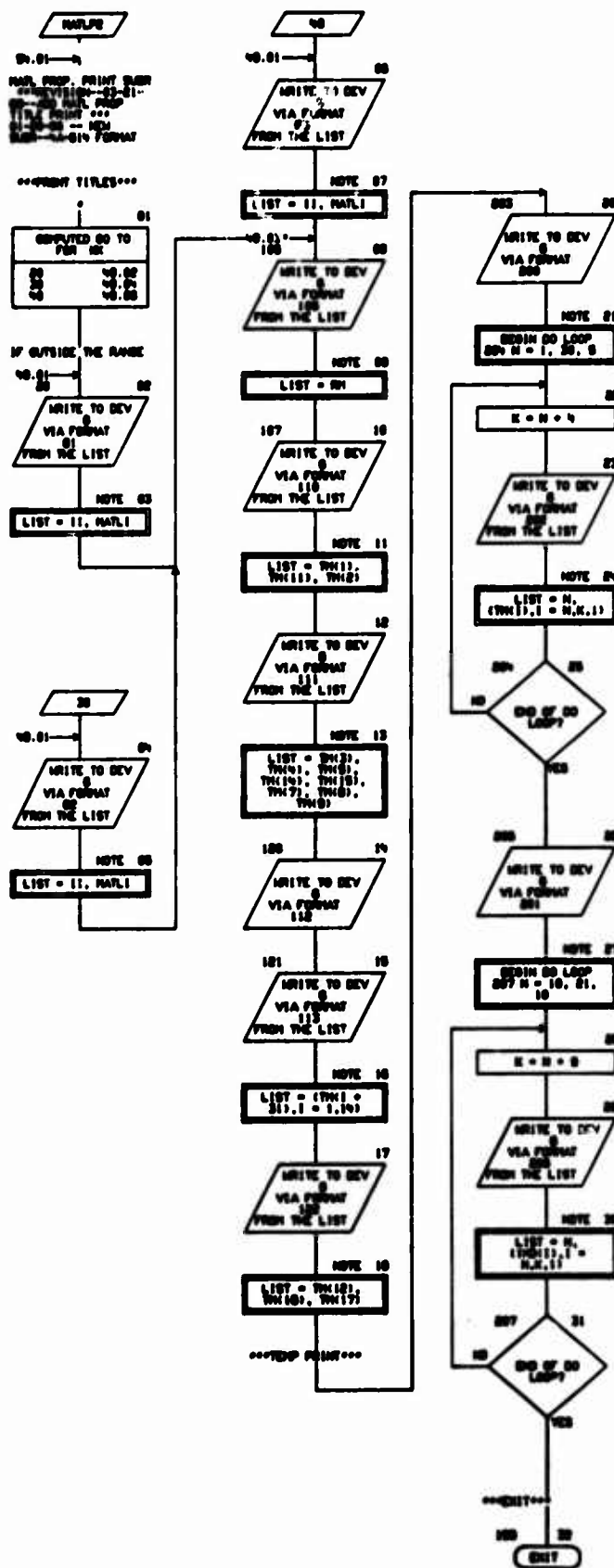
      OPEN TCDH4001
      DIMENSION S(2000),T(2000),SC(100),ND(200)
      DIMENSION TD(200),TH(100),TY(20)
      EQUIVALENCE (S(1),TCDH(1)),(T(1),TCDH(2001)),(SC(1),TCDH(4101)),
        (ND(1),TCDH(4201))
      EQUIVALENCE (T(1001),TD(1)),(T(1001),TH(1)),(T(1001),TY(1))
      EQUIVALENCE (ND(101),I), (ND(103),K), (ND(104),L), (ND(100),N)
00  FORM(10),I,K,20*** MATL TEMPERATURE ERROR ***/K,0+MATL NO.,
    P5.1,20 THERE IS ONE TEMPERATURE ON FILE,/I,K,13+REQD. TDP. =,
    P7.1,20,10+MEASD TDP. =/7.1)
01  FORM(1000000,I,K,20*** MATL TEMPERATURE ERROR ***/K,0+MATL NO.,
    P5.1,20,20+TEMPERATURE IS BEYND RANGE OF TABLE,/I,K,
    13+REQD. TDP. =/7.1,20,10+LAST TDP. =/7.1)

```

**COURT TITLE - INTRODUCTORY COMMENTS**

#####  
SUBMITTING PARTY  
#####

CHART TITLE - SUBROUTINE NATL1



[illegible]

**COURT TITLE - INTRODUCTORY COMMENTS**

SUBMIT THE FORMS!

CDSH TITLE - SUBROUTINE NEWFL

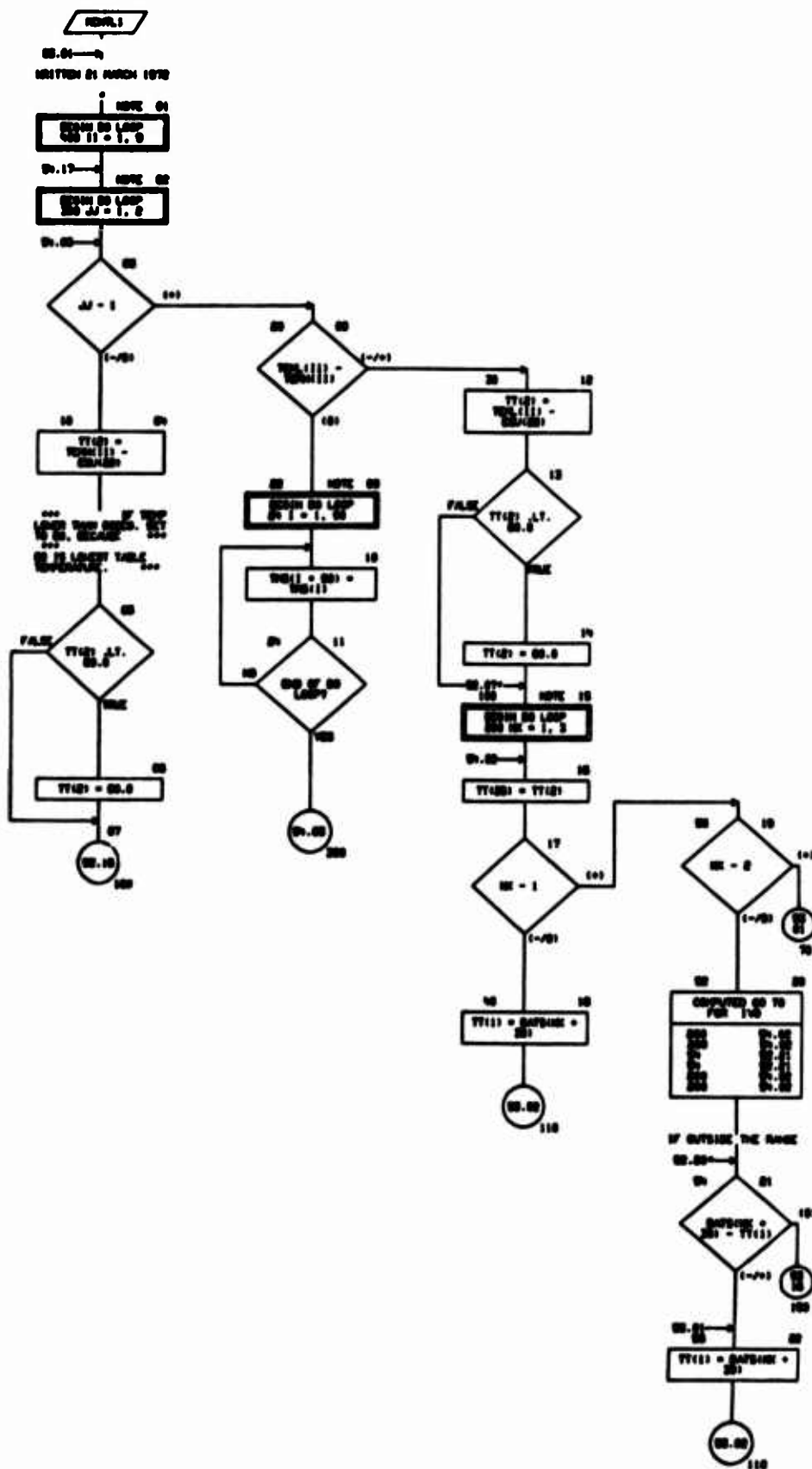


CHART TITLE - SUBROUTINE MONTH

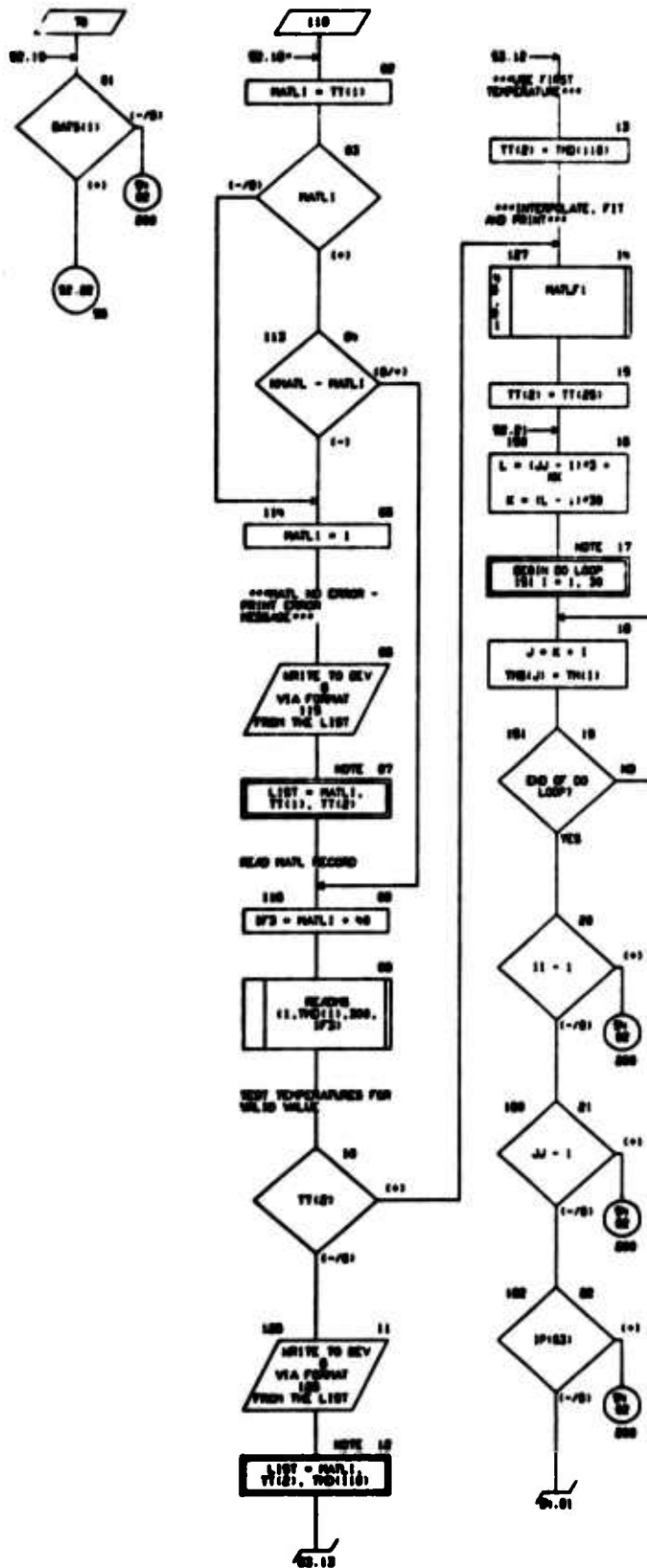
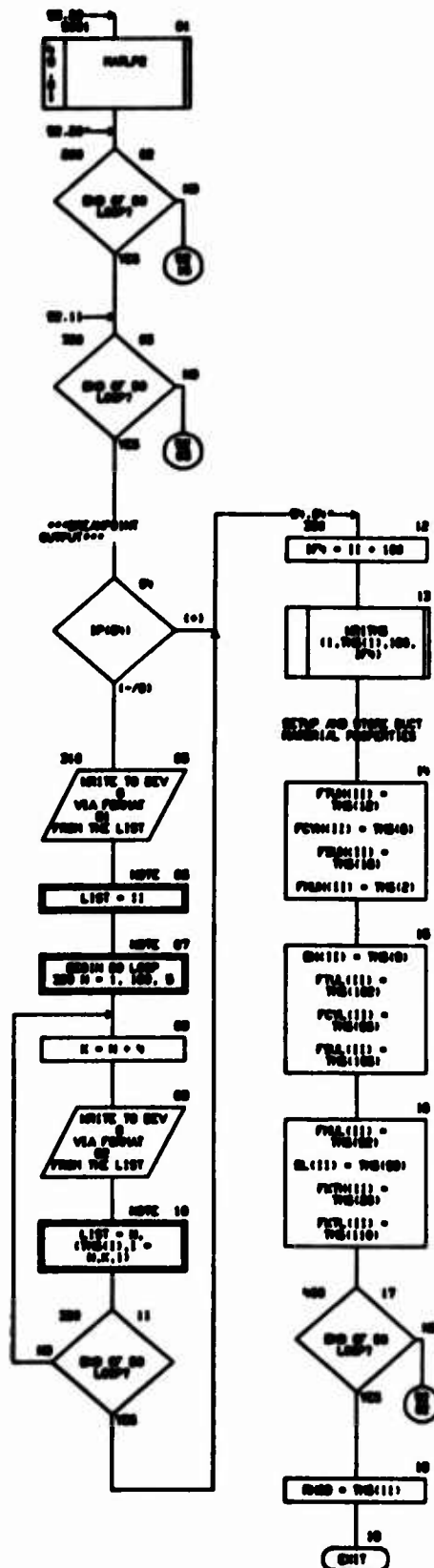


CHART TITLE - BEEP/THINE FEAR.1



## SHIRT TITLE - NON-PROCEDURAL STATEMENTS

```

      COPEN TCON(400)
      COPEN /PRINT/ (P100)
      DIMENSION D(2000),T(2000),DC(100),ND(200)
      DIMENSION SGM(200)
      DIMENSION TDM(10),TDL(10)
      DIMENSION SDF(40)
      DIMENSION TDM(200),TDL(200),TTC(20),TTS(100)
      DIMENSION FPM(10),FTL(10),FTM(10),FTL(10),FPM(10),FBL(10),
      FPM(10),FBL(10),DM(10),DL(10),FTM(10),FTL(10)
      EQUIVALENCE (D(1),TDM(1)),(T(1),TDM(200)),(DC(1),TCON(410)),
      (ND(1),TCON(420))
      EQUIVALENCE (D(61),SGM(1))
      EQUIVALENCE (D(66),SDF(1))
      EQUIVALENCE (T(34),TDM(1)),(T(35),TDL(1))
      EQUIVALENCE (T(100),TDM(1)),(T(101),TDM(1)),(T(102),TTC(1)),
      (T(103),TTS(1))
      EQUIVALENCE (T(104),FPM(1)),(T(105),FTL(1)),(T(106),FTM(1)),
      (T(107),FTL(1)),(T(108),FPM(1)),(T(109),FBL(1)),
      (T(110),FPM(1)),(T(111),FBL(1)),(T(112),DM(1)),
      (T(113),DL(1)),(T(114),FTM(1)),(T(115),FTL(1))
      EQUIVALENCE (T(116),R40)
      EQUIVALENCE (ND(63),I7), (ND(64),I7)
      EQUIVALENCE (ND(65),APWL), (ND(66),PATL)
      EQUIVALENCE (ND(101),I), (ND(102),J), (ND(103),K), (ND(104),L)
      EQUIVALENCE (ND(105),N)
      EQUIVALENCE (ND(107),I), (ND(108),J), (ND(109),K)
      EQUIVALENCE (ND(112),I40)
      EQUIVALENCE (ND(113),I80)
115  FORMAT (40+ '***MFL INPUT ERROR. ASSIGNED MFL NO. 1.***',/INDEX,
      13,70.1,70.1)
120  FORMAT (20+ '***MFL TEMPERATURE ERROR. MFL NO.,P4.1,ON READ.,
      P7.1,ON SEC. ASSIGNED TDP=P7.1,ON SEC.)
01  FORMAT(1H1,3X,50THS REDIGN PROFILE POINT =,13,50H,
      21H** MFL1 = (P10) **)
02  FORMAT(1H 2H,13,50H.0)

```

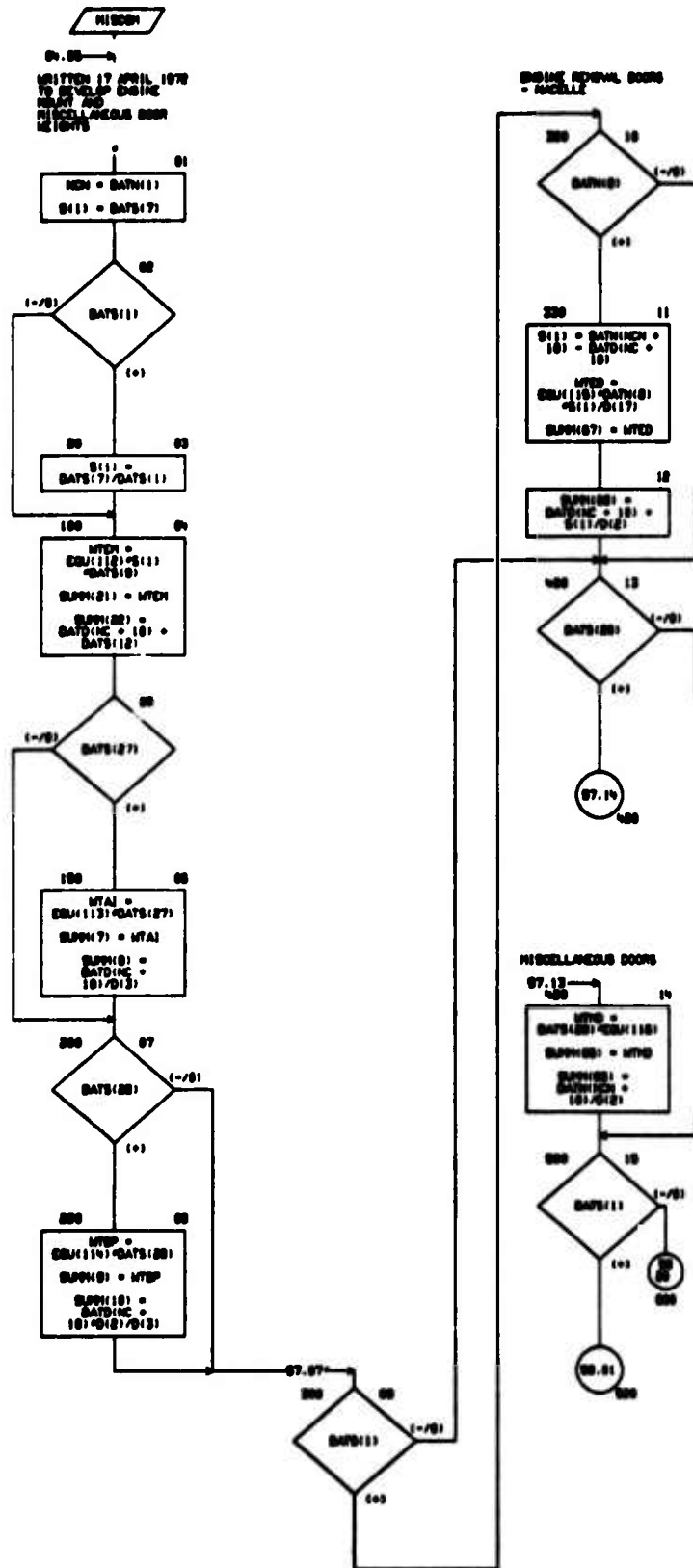
05/05/75

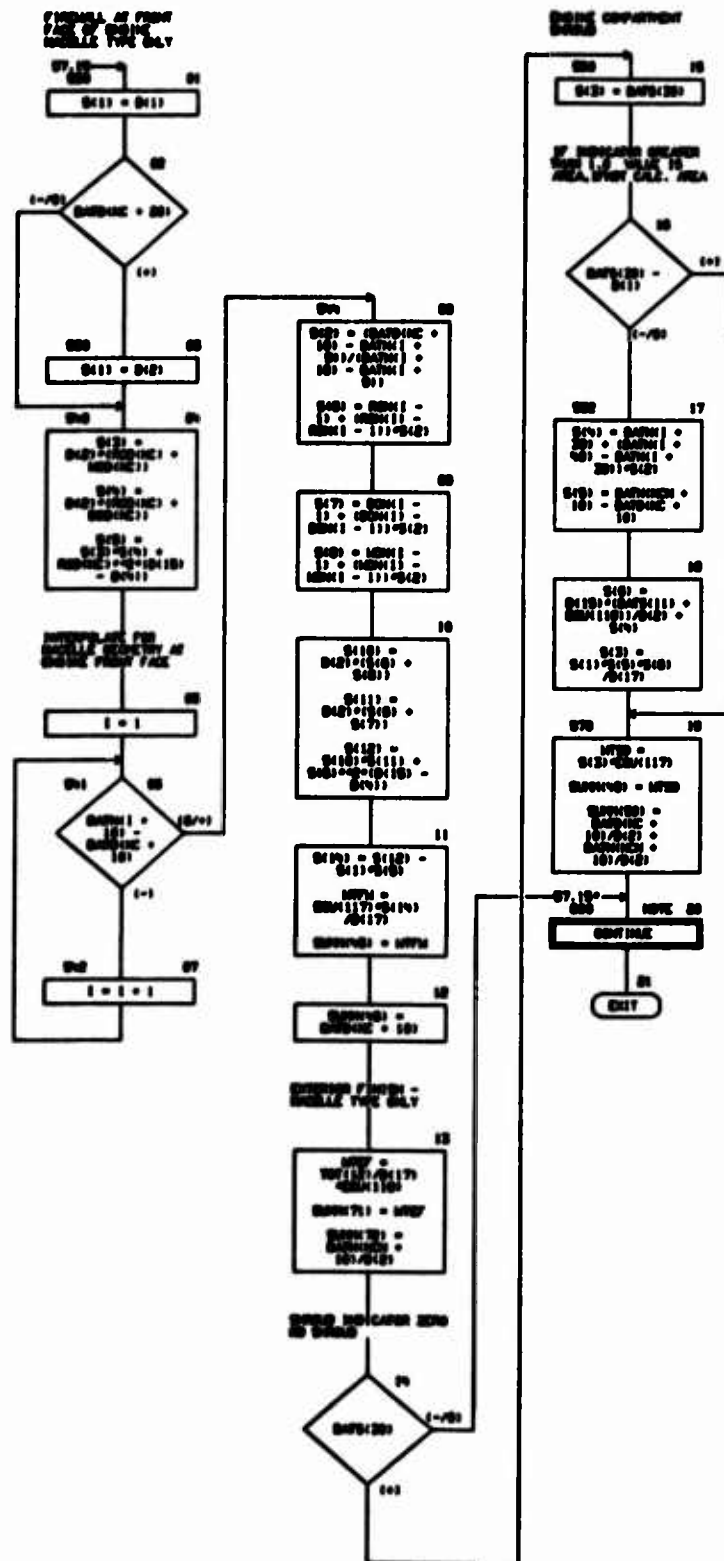
AIRFLOW CHART SET - DEEP AIR INJECTION SYSTEM MODEL PAGE 05

CHART TITLE - INTERJECTOR CHARTS

RESTARTING HUBCH

CHART TITLE - SUBROUTINE MISCON



**SHORT TITLE - SUBROUTINE MISCN**

CURT TITLE - NON-FREEDMAN STATEMENTS

```

COMMON T00H(400)
DIMENSION S(4000),T(8000),DC(100),JD(800)
DIMENSION DB(400)
DIMENSION SPTS(40),SPTS(80),SPTS(80)
DIMENSION SUPH(800)
DIMENSION S(100),TOT(100)
DIMENSION NDB(10),JDB(10),SDB(10)
DIMENSION NDB(10),SDB(10),SDB(10)
DIMENSIONAL DB(1),T00H(100),T(100),T00H(800),DC(100),T00H(4100),
JDB(1),T00H(800)
DIMENSIONAL DB(10),SDB(10)
DIMENSIONAL DB(20),SPTS(100),DB(20),SPTS(100),DB(20),SPTS(100)
DIMENSIONAL DB(170),SUPH(100)
DIMENSIONAL T(10),S(100),T(100),TOT(100)
DIMENSIONAL T00(40),JDB(10),T00(40),JDB(10),T00(40),JDB(10),
T00(40),JDB(10),T00(40),JDB(10)
DIMENSIONAL T00(40),JDB(10),T00(40),JDB(10),T00(40),JDB(10)
DIMENSIONAL T00(10),JDB(10),T00(10),JDB(10),T00(10),JDB(10)
DIMENSIONAL T00(10),JDB(10),T00(10),JDB(10),T00(10),JDB(10)
DIMENSIONAL DB(100),1)
DIMENSIONAL DB(100),DC(100),JDB(10)

```

05/05/79

AUTOFLEX CHART SET - SHEEP AIR INJECTION SYSTEM MODULE PAGE 05

CHART TITLE - INTRODUCTORY COMMENTS

\*\*\*\*\*  
ROUTINE MODULE  
\*\*\*\*\*



CHART TITLE - SUBROUTINE NACDL

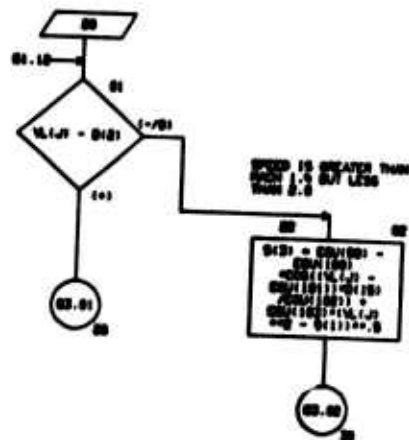


CHART TITLE - SUBROUTINE NACLE

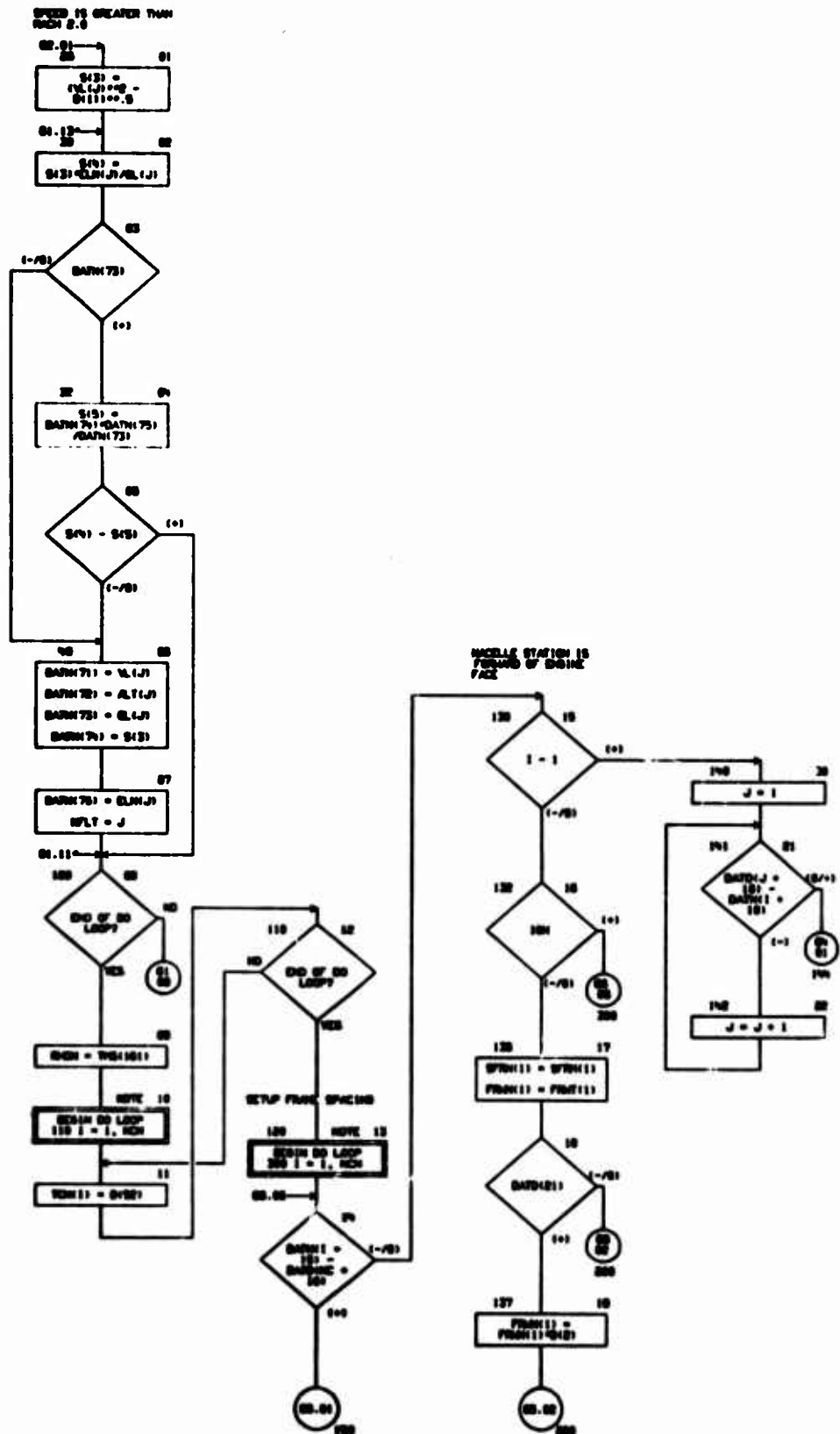


CHART TITLE - SUBROUTINE NCCLC

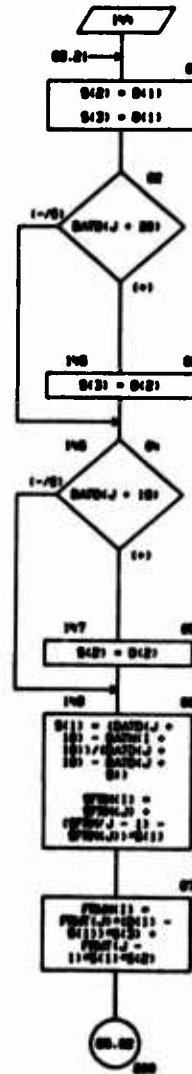
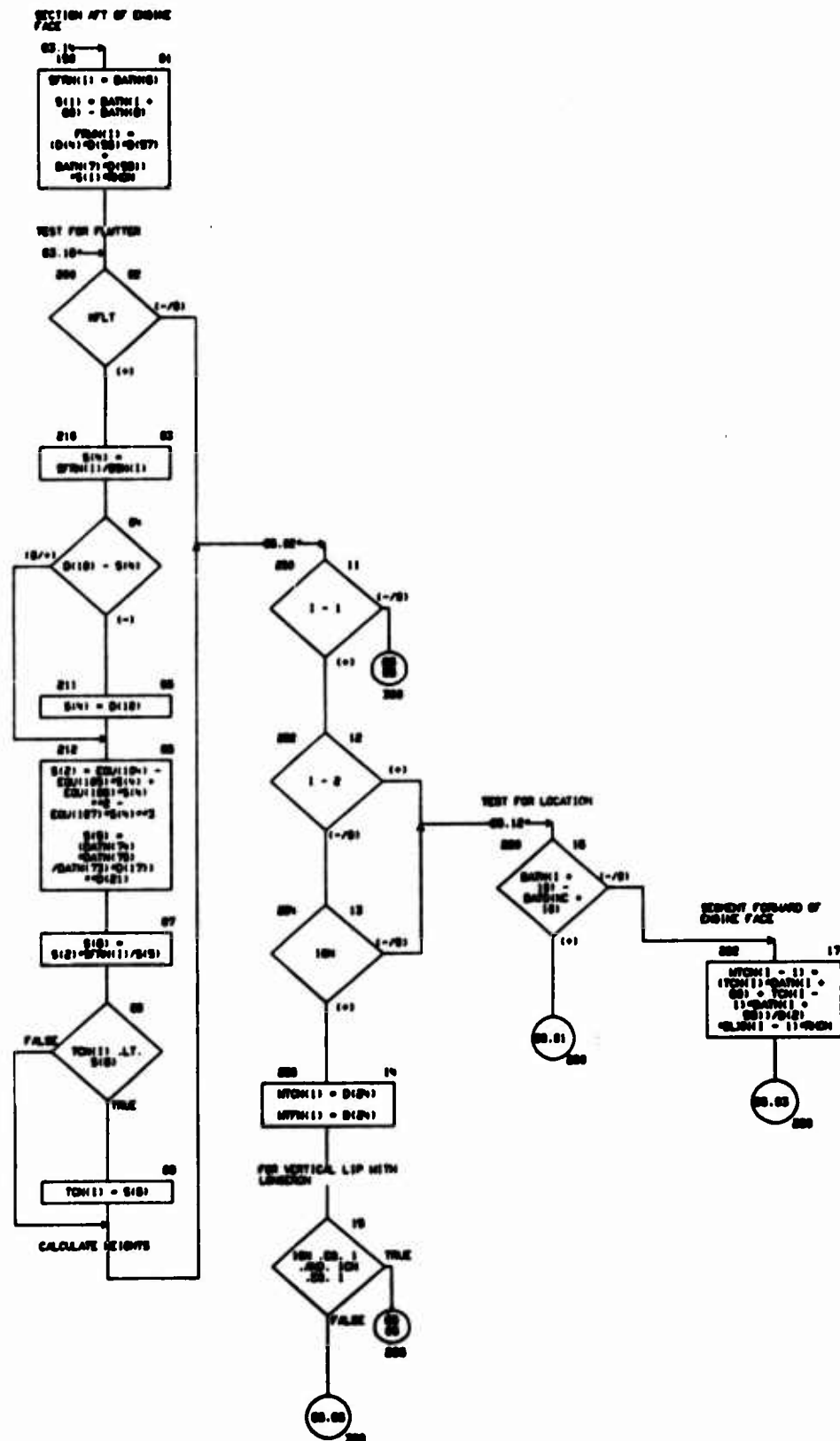


CHART TITLE - SUBROUTINE MODALS





## CHART TITLE - NON-PROCEDURAL STATEMENTS

```

COMMON TCMH400)
COMMON /PRINT/ IP100)
COMMON /INIC/ INIC100)
DIMENSION D12000),T12000),EC100),J04000)
DIMENSION ELM100),DARK100),BARK100)
DIMENSION SUP100)
DIMENSION S100)
DIMENSION TOT100)
DIMENSION T00100)
DIMENSION BATS400)
DIMENSION TITLE(20), BARK100)
DIMENSION ALT100),VL100),EL100)
DIMENSION SFTH100),FTH100)
DIMENSION DEN100),DEN100),DEN100),DEN100),DEN100)
DIMENSION DEN100),ELN100)
DIMENSION SFTH100),DEN100),ACEN100)
DIMENSION ELM100)
DIMENSION TCM100),SFTH100),FTH100),JTCM100),JFTH100)
DIMENSION MFLN100)
EQUIVALENCE (D100),TCM100), (T100),TCM100000), (EC100),TCM100000),
DEN100),TCM100000)
EQUIVALENCE (D000),ELN100), (D1000),DARK100), (D000),BARK100)
EQUIVALENCE (D1000),BATS100)
EQUIVALENCE (D1000),BARK100), (D1000),TITLE100)
EQUIVALENCE (D1000),SUP100)
EQUIVALENCE (T100),S100)
EQUIVALENCE (T100),TOT100)
EQUIVALENCE (T1000),ALT100), (T1000),VL100), (T1000),EL100)
EQUIVALENCE (T1000),SFTH100), (T1000),FTH100)
EQUIVALENCE (T1000),DEN100), (T1000),DEN100), (T1000),DEN100),
(T1000),DEN100), (T1000),ELN100)
EQUIVALENCE (T1000),DEN100), (T1000),ELN100)
EQUIVALENCE (T1000),SFTH100), (T1000),DEN100), (T1000),ACEN100)
EQUIVALENCE (T1000),ELN100)
EQUIVALENCE (ELN100),J0400)
EQUIVALENCE (T1000),TCM100), (T1000),SFTH100), (T1000),FTH100),
(T1000),JTCM100), (T1000),JFTH100)
EQUIVALENCE (T1000),JELN100)
EQUIVALENCE (T1000),T00100)
EQUIVALENCE (D000),JPA00)
EQUIVALENCE (D000),JPA)
EQUIVALENCE (D000),J)
EQUIVALENCE (D000),J00), (D000),J00), (D000),J00),
(D000),J00), (D000),J00), (D000),J00), (D000),J00),
FORMAT(MH,BA10,EL,FM** MOLE - IP170) **/IX,BA10)
01 FORMAT(100,FM,FM** MOLE GEOMETRY - SECTION DATA **/
      /FM,100,FM TYPE =,13,X,100,FM CODE =,13/FM,
      300T,3X,400T,3X,500T,3X,600T,3X,700T,3X,800T,3X,900T,3X,
      000,3X,100,3X,200,3X,300,3X,400,3X,500,3X,600,3X,700,3X,800,3X,900,3X,
02 FORMAT(17,100,1)
03 FORMAT( / 3X,300T,4X,400T,4X,500T,4X,600T,4X,700T,4X,800T,4X,900T,
04 FORMAT(3X,17,100,2/0,0)
05 FORMAT( / 3X,300T,4X,400T,4X,500T,4X,600T,4X,700T,4X,800T,4X,900T,
      3X,100T,1000T)
06 FORMAT(3X,17,100,2)
07 FORMAT(3X,400T,17,100,2)

```

02/25/74

AVIATION CHART 551 - DEEP AIR INJECTION SYSTEM MANUAL PAGE 00

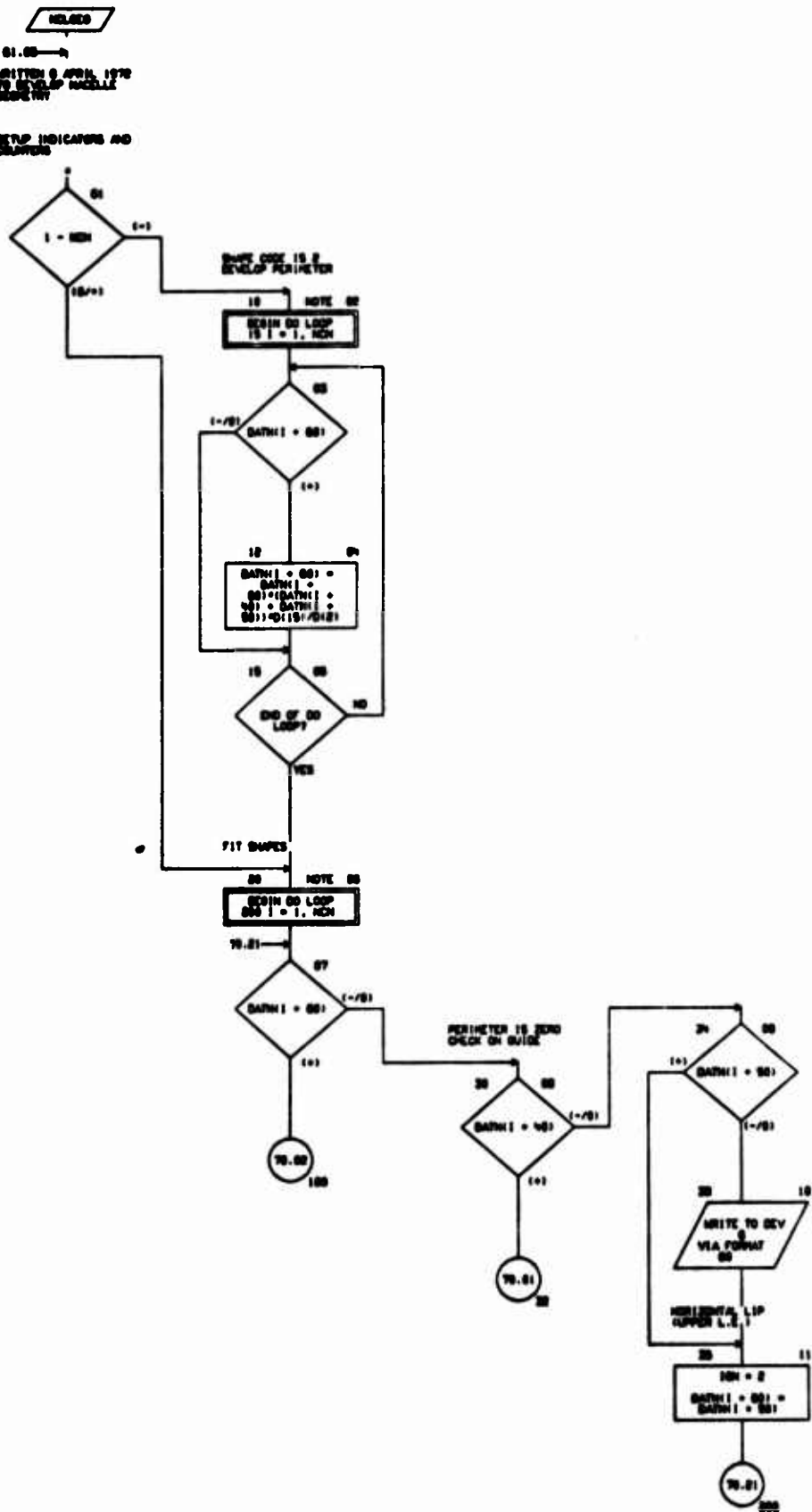
CHART TITLE - INTRODUCTORY COMMENTS

.....  
DISTRIBUTION RELEASE  
.....

CHART TITLE - SUBROUTINE NOLDED

01.00  
 WRITTEN 6 APRIL 1970  
 TO DEVELOP MODULE  
 0000000

SETUP INDICATORS AND  
 COUNTERS



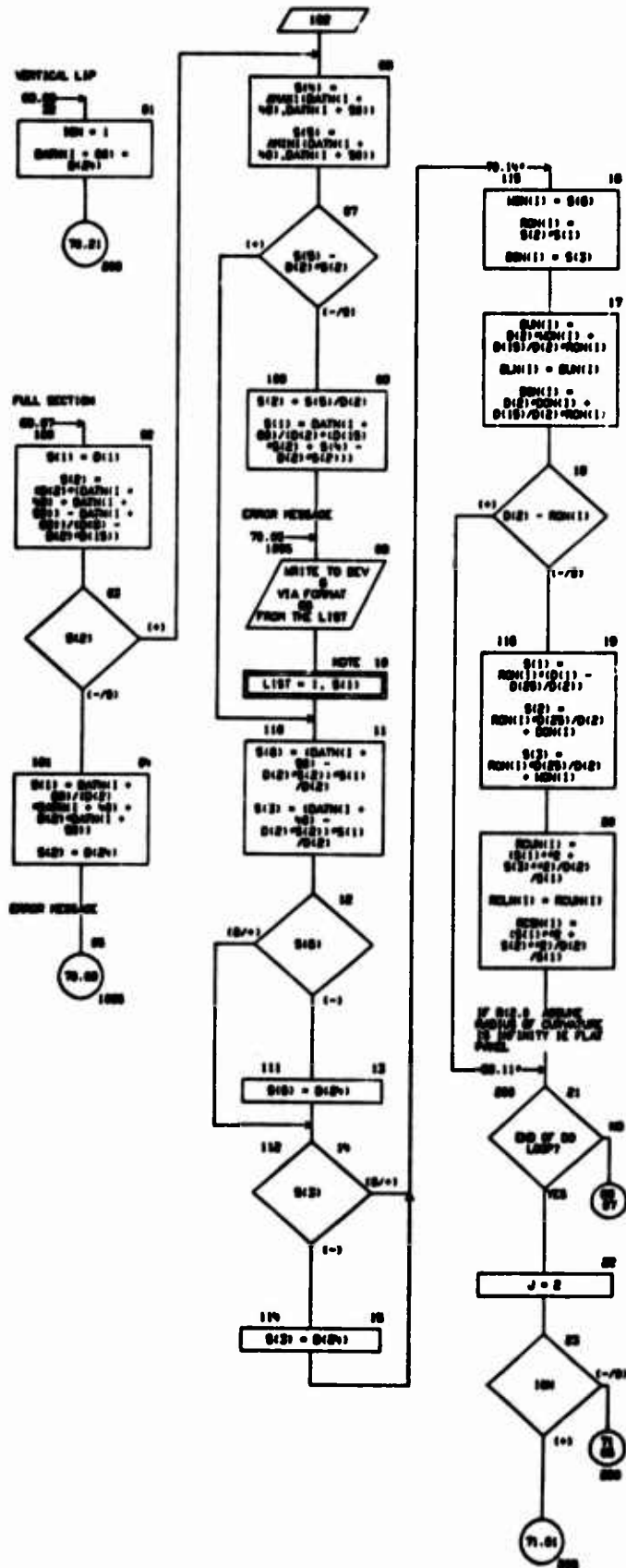
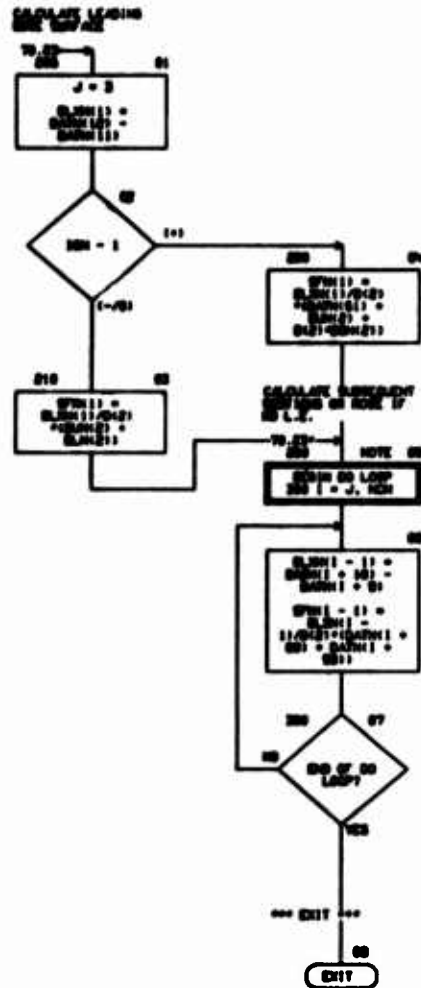


CHART TITLE - SUBROUTINE HELD



## CHART TITLE - NON-PROCEDURAL STATEMENTS

```

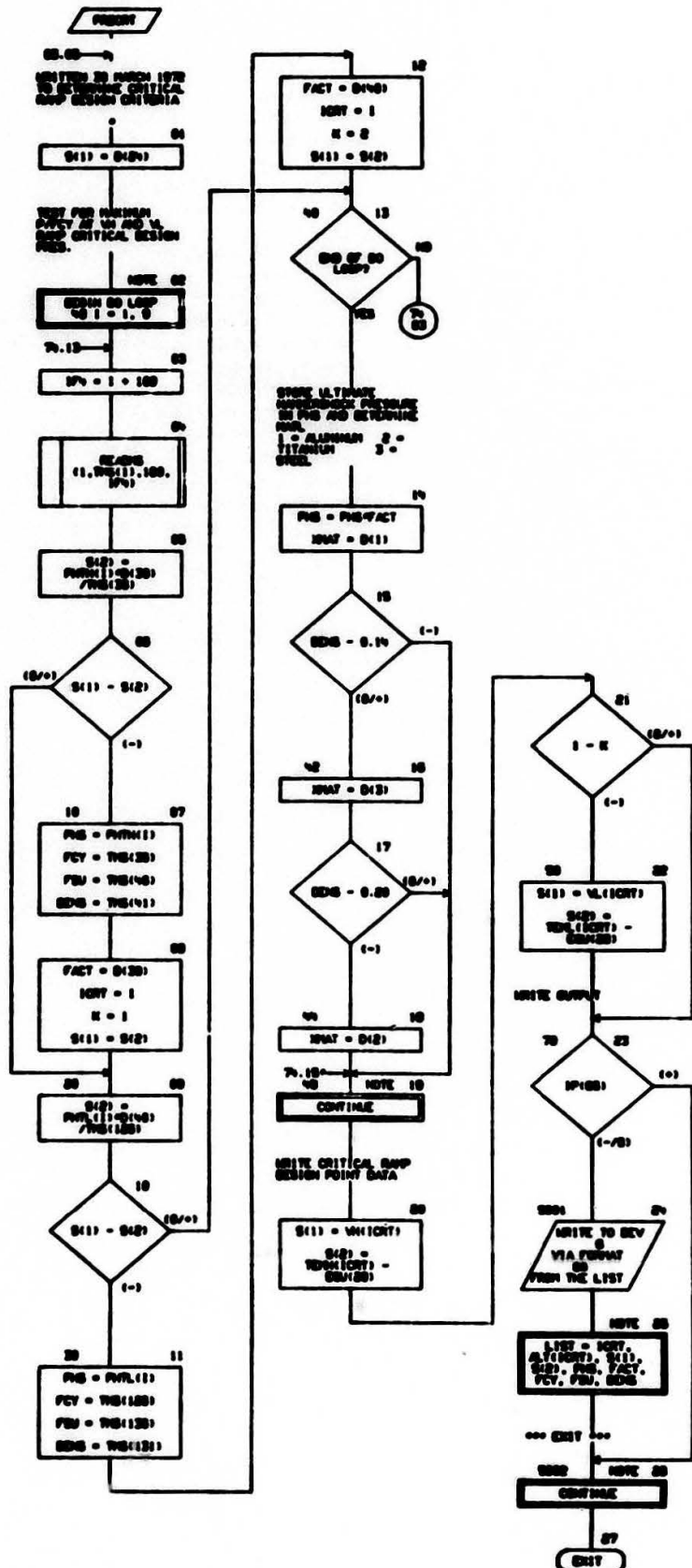
COMMON TCON(400)
DIMENSION D(2000),T(2000),DC(100),ND(200)
DIMENSION DATH(60)
DIMENSION S(100)
DIMENSION MDH(10),RDN(10),SDH(10),BLH(10),BLN(10),SPH(10)
DIMENSION BLH(10),SPH(10),RDN(10),BLN(10),RDN(10)
EQUIVALENCE (D(1),TCON(1)),(T(1),TCON(2001)),(DC(1),TCON(4101)),
  (ND(1),TCON(4001))
EQUIVALENCE (D(60),DATH(1))
EQUIVALENCE (T(1),S(1))
EQUIVALENCE (T(70),MDH(1)),(T(70),RDN(1)),(T(77),SDH(1)),
  (T(70),BLH(1)),(T(70),BLN(1)),(T(80),SPH(1))
EQUIVALENCE (T(81),BLH(1)),(T(82),SPH(1)),(T(83),RDN(1)),
  (T(84),BLN(1)),(T(85),RDN(1))
EQUIVALENCE (ND(10),1),(ND(10),J)
EQUIVALENCE (ND(12),NDH),(ND(12),NDH),(ND(100),10H)
00  FORMAT(4HWARNING FROM HOLDED IN AIR INDUCTION SYSTEM /
  4H,20HACELLE LIP GEOMETRY ERROR )
00  FORMAT(4HWARNING FROM HOLDED IN AIR INDUCTION SYSTEM /
  11X, 13SECTION, 113, 30H IS RECTANGLE OR ROUNDED RECT.,
  13CORRECTION IS, 170.3 )

```

CHART TITLE - INTRODUCTORY COMMENTS

\*\*\*\*\*  
SUBROUTINE PRECUT  
\*\*\*\*\*

**CHART TITLE - SUBROUTINE PREFIX**



CURT TITLE - NON-PROCEDURAL STATEMENTS

```

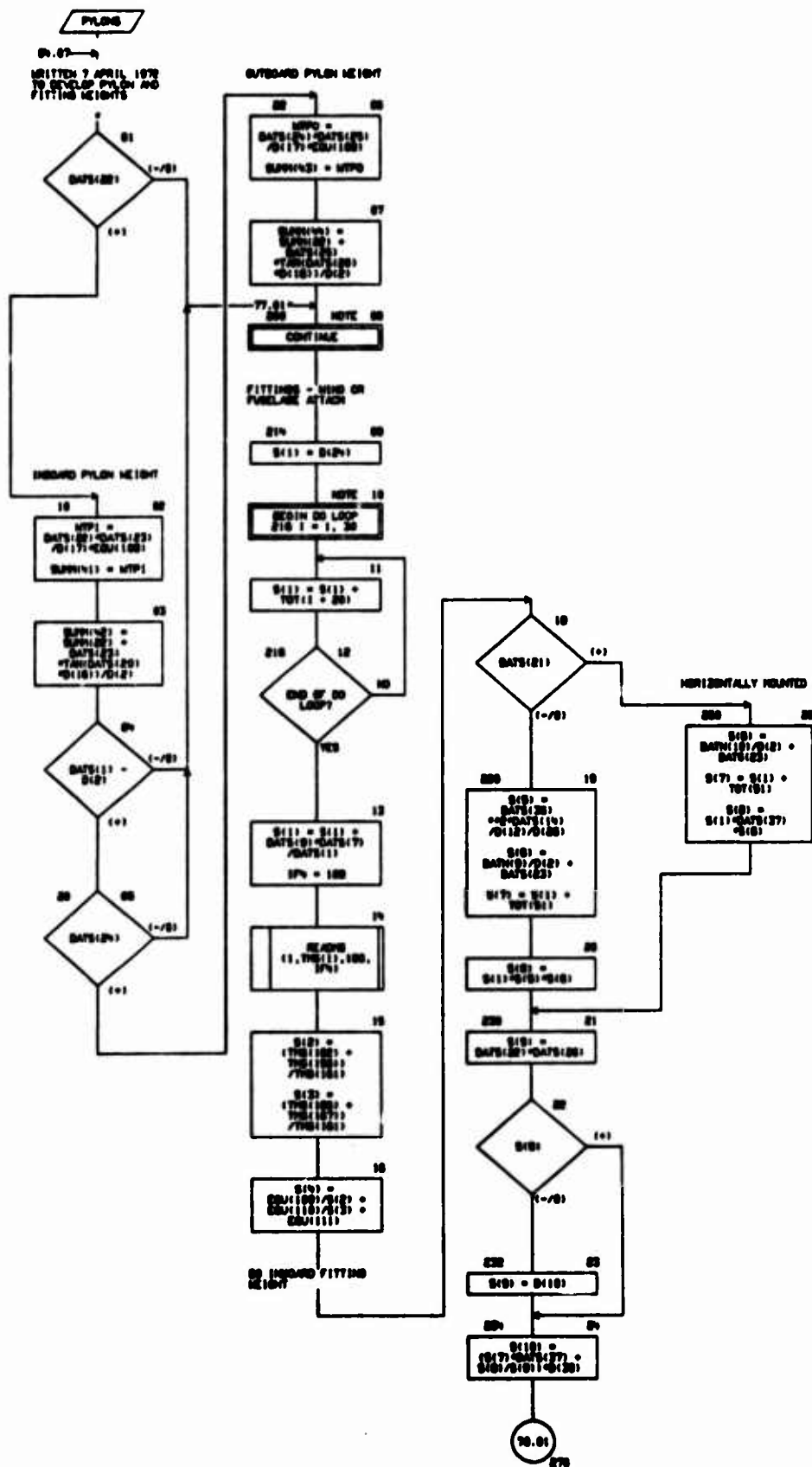
COMMON TCON(1400)
COMMON /SPRINT/ SP(100)
DIMENSION D(2000),T(2000),DC(100),JCH(200)
DIMENSION ECU(200)
DIMENSION BATH(100)
DIMENSION S(100)
DIMENSION AL(10),WH(10),VL(10),TCON(10),TDL(10)
DIMENSION PWTN(10),PWL(10)
DIMENSION TWS(100)
EQUIVALENCE (D(1),TCON(1)),(T(1),TCON(200)),(DC(1),TCON(410)),
  (D(1),TCON(430))
EQUIVALENCE (D(01),ECU(1))
EQUIVALENCE (D(401),BATH(1)),(BATH(2),PWS),(BATH(12),JCTY),
  (BATH(13),JFU),(BATH(14),DCS),(BATH(15),JMT),(BATH(16),FACT)
EQUIVALENCE (T(1),S(1))
EQUIVALENCE (T(201),AL(1)),(T(202),WH(1)),(T(271),VL(1)),
  (T(21),TCON(1)),(T(20),TDL(1))
EQUIVALENCE (T(401),PWTN(1)),(T(402),PWL(1))
EQUIVALENCE (T(100),TWS(1))
EQUIVALENCE (D(101),J),(D(102),J1),(D(103),J2),(D(117),SCRT)
EQUIVALENCE (D(100),NPAGE),(D(04),JF4)
00  FORMAT(1H,1X,30H*** RAMP DESIGN CONDITIONS ***.1X,
  2H** FRECY - SP(00) **//
  1X,0P0NT,2X,14X,0ALTTITLE,1X,F10.24X,0SPEED,17X,
  F10.24X,10TEMPERATURE - F,7X,F10.24X,10PRESSURE - PSIA,
  7X,F10.24X,00LIMIT TO ULT. FACTOR,5X,F10.24X,
  17COMPRESSION YIELD,5X,F10.24X,02ALTIMATE SHEAR STRESS,
  F11.24X,10MATERIAL DENSITY,11X,F0.3)

```

CHART TITLE - INTRODUCTORY COMMENTS

.....  
SUBROUTINE PLANS  
.....

CHART TITLE - SUBROUTINE PYLON



383

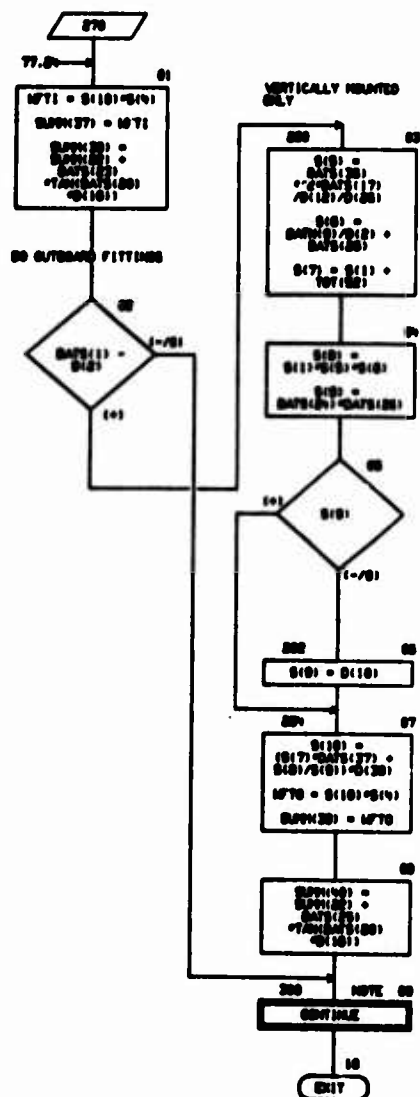


CHART TITLE - NON-PROCEDURAL STATEMENTS

```

DIMENSION CDM(200),BAT(100),BATH(50)
COMMON TCDW(100)
DIMENSION D(2000),T(2000),DC(100),JD(200)
DIMENSION SUPW(50)
DIMENSION S(100),TOT(100),TW(100)
EQUIVALENCE (D(1),TCDW(1)),(T(1),TCDW(200)),(DC(1),TCDW(101)),
             (JD(1),TCDW(201))
EQUIVALENCE (D(101),CDM(1)),(D(201),BAT(1)),(D(301),BATH(1))
EQUIVALENCE (D(1701),SUPW(1))
EQUIVALENCE (T(1),S(1)),(T(101),TOT(1)),(T(1001),TW(1))
EQUIVALENCE (TOT(51),MTP(1)),(TOT(102),MTP(2)),(TOT(153),MTP(3)),
             (TOT(204),MTP(4))
EQUIVALENCE (MTP(5),MTP(5)),(MTP(101),1)

```

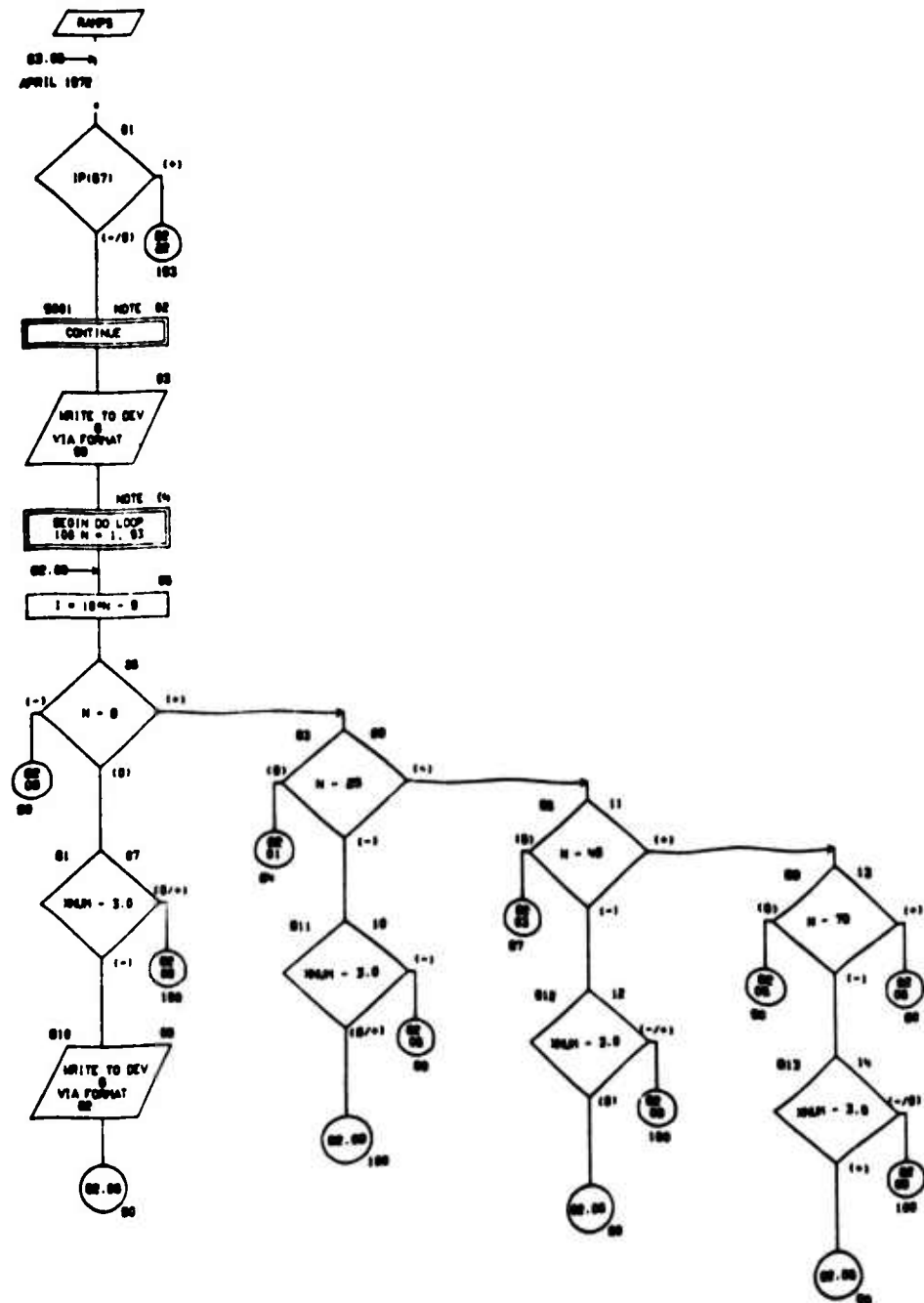
05/05/74

REFUEL GWT SET - 245P AIR INJECTION SYSTEM HEDALE PAGE 00

GWT TITLE - INTERACTORY COMMENTS

#####  
SUBROUTINE GWTG  
#####

CHART TITLE - SUBROUTINE RAPP



```

graph TD
    Start(( )) --> S1[01.00]
    S1 --> D1{01.01  
MAIN = 2.0  
(-/+)}
    D1 --> W1[/WRITE TO DEV  
VIA FORMAT  
00/]
    W1 --> S2[01.02]
    S2 --> D2{01.03  
END OF DO  
LOOP?}
    D2 --> W2[/WRITE TO DEV  
VIA FORMAT  
101  
FROM THE LIST/]
    W2 --> S3[01.04]
    S3 --> D3{01.05  
END OF DO  
LOOP?}
    D3 --> W3[/WRITE TO DEV  
VIA FORMAT  
102  
FROM THE LIST/]
    W3 --> S4[01.06]
    S4 --> D4{01.07  
END OF DO  
LOOP?}
    D4 --> W4[/WRITE TO DEV  
VIA FORMAT  
103  
FROM THE LIST/]
    W4 --> S5[01.08]
    S5 --> D5{01.09  
END OF DO  
LOOP?}
    D5 --> W5[/WRITE TO DEV  
VIA FORMAT  
104  
FROM THE LIST/]
    W5 --> S6[01.10]
    S6 --> D6{01.11  
END OF DO  
LOOP?}
    D6 --> W6[/WRITE TO DEV  
VIA FORMAT  
105  
FROM THE LIST/]
    W6 --> S7[01.12]
    S7 --> D7{01.13  
END OF DO  
LOOP?}
    D7 --> W7[/WRITE TO DEV  
VIA FORMAT  
106  
FROM THE LIST/]
    W7 --> S8[01.14]
    S8 --> D8{01.15  
END OF DO  
LOOP?}
    D8 --> W8[/WRITE TO DEV  
VIA FORMAT  
107  
FROM THE LIST/]
    W8 --> S9[01.16]
    S9 --> D9{01.17  
END OF DO  
LOOP?}
    D9 --> W9[/WRITE TO DEV  
VIA FORMAT  
108  
FROM THE LIST/]
    W9 --> S10[01.18]
    S10 --> D10{01.19  
END OF DO  
LOOP?}
    D10 --> W10[/WRITE TO DEV  
VIA FORMAT  
109  
FROM THE LIST/]
    W10 --> S11[01.20]
    S11 --> D11{01.21  
END OF DO  
LOOP?}
    D11 --> W11[/WRITE TO DEV  
VIA FORMAT  
110  
FROM THE LIST/]
    W11 --> S12[01.22]
    S12 --> D12{01.23  
END OF DO  
LOOP?}
    D12 --> W12[/WRITE TO DEV  
VIA FORMAT  
111  
FROM THE LIST/]
    W12 --> S13[01.24]
    S13 --> D13{01.25  
END OF DO  
LOOP?}
    D13 --> W13[/WRITE TO DEV  
VIA FORMAT  
112  
FROM THE LIST/]
    W13 --> S14[01.26]
    S14 --> D14{01.27  
END OF DO  
LOOP?}
    D14 --> W14[/WRITE TO DEV  
VIA FORMAT  
113  
FROM THE LIST/]
    W14 --> S15[01.28]
    S15 --> D15{01.29  
END OF DO  
LOOP?}
    D15 --> W15[/WRITE TO DEV  
VIA FORMAT  
114  
FROM THE LIST/]
    W15 --> S16[01.30]
    S16 --> D16{01.31  
END OF DO  
LOOP?}
    D16 --> W16[/WRITE TO DEV  
VIA FORMAT  
115  
FROM THE LIST/]
    W16 --> S17[01.32]
    S17 --> D17{01.33  
END OF DO  
LOOP?}
    D17 --> W17[/WRITE TO DEV  
VIA FORMAT  
116  
FROM THE LIST/]
    W17 --> S18[01.34]
    S18 --> D18{01.35  
END OF DO  
LOOP?}
    D18 --> W18[/WRITE TO DEV  
VIA FORMAT  
117  
FROM THE LIST/]
    W18 --> S19[01.36]
    S19 --> D19{01.37  
END OF DO  
LOOP?}
    D19 --> W19[/WRITE TO DEV  
VIA FORMAT  
118  
FROM THE LIST/]
    W19 --> S20[01.38]
    S20 --> D20{01.39  
END OF DO  
LOOP?}
    D20 --> W20[/WRITE TO DEV  
VIA FORMAT  
119  
FROM THE LIST/]
    W20 --> S21[01.40]
    S21 --> D21{01.41  
END OF DO  
LOOP?}
    D21 --> W21[/WRITE TO DEV  
VIA FORMAT  
120  
FROM THE LIST/]
    W21 --> S22[01.42]
    S22 --> D22{01.43  
END OF DO  
LOOP?}
    D22 --> W22[/WRITE TO DEV  
VIA FORMAT  
121  
FROM THE LIST/]
    W22 --> S23[01.44]
    S23 --> D23{01.45  
END OF DO  
LOOP?}
    D23 --> W23[/WRITE TO DEV  
VIA FORMAT  
122  
FROM THE LIST/]
    W23 --> S24[01.46]
    S24 --> D24{01.47  
END OF DO  
LOOP?}
    D24 --> W24[/WRITE TO DEV  
VIA FORMAT  
123  
FROM THE LIST/]
    W24 --> S25[01.48]
    S25 --> D25{01.49  
END OF DO  
LOOP?}
    D25 --> W25[/WRITE TO DEV  
VIA FORMAT  
124  
FROM THE LIST/]
    W25 --> S26[01.50]
    S26 --> D26{01.51  
END OF DO  
LOOP?}
    D26 --> W26[/WRITE TO DEV  
VIA FORMAT  
125  
FROM THE LIST/]
    W26 --> S27[01.52]
    S27 --> D27{01.53  
END OF DO  
LOOP?}
    D27 --> W27[/WRITE TO DEV  
VIA FORMAT  
126  
FROM THE LIST/]
    W27 --> S28[01.54]
    S28 --> D28{01.55  
END OF DO  
LOOP?}
    D28 --> W28[/WRITE TO DEV  
VIA FORMAT  
127  
FROM THE LIST/]
    W28 --> S29[01.56]
    S29 --> D29{01.57  
END OF DO  
LOOP?}
    D29 --> W29[/WRITE TO DEV  
VIA FORMAT  
128  
FROM THE LIST/]
    W29 --> S30[01.58]
    S30 --> D30{01.59  
END OF DO  
LOOP?}
    D30 --> W30[/WRITE TO DEV  
VIA FORMAT  
129  
FROM THE LIST/]
    W30 --> S31[01.60]
    S31 --> D31{01.61  
END OF DO  
LOOP?}
    D31 --> W31[/WRITE TO DEV  
VIA FORMAT  
130  
FROM THE LIST/]
    W31 --> S32[01.62]
    S32 --> D32{01.63  
END OF DO  
LOOP?}
    D32 --> W32[/WRITE TO DEV  
VIA FORMAT  
131  
FROM THE LIST/]
    W32 --> S33[01.64]
    S33 --> D33{01.65  
END OF DO  
LOOP?}
    D33 --> W33[/WRITE TO DEV  
VIA FORMAT  
132  
FROM THE LIST/]
    W33 --> S34[01.66]
    S34 --> D34{01.67  
END OF DO  
LOOP?}
    D34 --> W34[/WRITE TO DEV  
VIA FORMAT  
133  
FROM THE LIST/]
    W34 --> S35[01.68]
    S35 --> D35{01.69  
END OF DO  
LOOP?}
    D35 --> W35[/WRITE TO DEV  
VIA FORMAT  
134  
FROM THE LIST/]
    W35 --> S36[01.70]
    S36 --> D36{01.71  
END OF DO  
LOOP?}
    D36 --> W36[/WRITE TO DEV  
VIA FORMAT  
135  
FROM THE LIST/]
    W36 --> S37[01.72]
    S37 --> D37{01.73  
END OF DO  
LOOP?}
    D37 --> W37[/WRITE TO DEV  
VIA FORMAT  
136  
FROM THE LIST/]
    W37 --> S38[01.74]
    S38 --> D38{01.75  
END OF DO  
LOOP?}
    D38 --> W38[/WRITE TO DEV  
VIA FORMAT  
137  
FROM THE LIST/]
    W38 --> S39[01.76]
    S39 --> D39{01.77  
END OF DO  
LOOP?}
    D39 --> W39[/WRITE TO DEV  
VIA FORMAT  
138  
FROM THE LIST/]
    W39 --> S40[01.78]
    S40 --> D40{01.79  
END OF DO  
LOOP?}
    D40 --> W40[/WRITE TO DEV  
VIA FORMAT  
139  
FROM THE LIST/]
    W40 --> S41[01.80]
    S41 --> D41{01.81  
END OF DO  
LOOP?}
    D41 --> W41[/WRITE TO DEV  
VIA FORMAT  
140  
FROM THE LIST/]
    W41 --> S42[01.82]
    S42 --> D42{01.83  
END OF DO  
LOOP?}
    D42 --> W42[/WRITE TO DEV  
VIA FORMAT  
141  
FROM THE LIST/]
    W42 --> S43[01.84]
    S43 --> D43{01.85  
END OF DO  
LOOP?}
    D43 --> W43[/WRITE TO DEV  
VIA FORMAT  
142  
FROM THE LIST/]
    W43 --> S44[01.86]
    S44 --> D44{01.87  
END OF DO  
LOOP?}
    D44 --> W44[/WRITE TO DEV  
VIA FORMAT  
143  
FROM THE LIST/]
    W44 --> S45[01.88]
    S45 --> D45{01.89  
END OF DO  
LOOP?}
    D45 --> W45[/WRITE TO DEV  
VIA FORMAT  
144  
FROM THE LIST/]
    W45 --> S46[01.90]
    S46 --> D46{01.91  
END OF DO  
LOOP?}
    D46 --> W46[/WRITE TO DEV  
VIA FORMAT  
145  
FROM THE LIST/]
    W46 --> S47[01.92]
    S47 --> D47{01.93  
END OF DO  
LOOP?}
    D47 --> W47[/WRITE TO DEV  
VIA FORMAT  
146  
FROM THE LIST/]
    W47 --> S48[01.94]
    S48 --> D48{01.95  
END OF DO  
LOOP?}
    D48 --> W48[/WRITE TO DEV  
VIA FORMAT  
147  
FROM THE LIST/]
    W48 --> S49[01.96]
    S49 --> D49{01.97  
END OF DO  
LOOP?}
    D49 --> W49[/WRITE TO DEV  
VIA FORMAT  
148  
FROM THE LIST/]
    W49 --> S50[01.98]
    S50 --> D50{01.99  
END OF DO  
LOOP?}
    D50 --> W50[/WRITE TO DEV  
VIA FORMAT  
149  
FROM THE LIST/]
    W50 --> S51[01.100]
    S51 --> D51{01.101  
END OF DO  
LOOP?}
    D51 --> W51[/WRITE TO DEV  
VIA FORMAT  
150  
FROM THE LIST/]
    W51 --> S52[01.102]
    S52 --> D52{01.103  
END OF DO  
LOOP?}
    D52 --> W52[/WRITE TO DEV  
VIA FORMAT  
151  
FROM THE LIST/]
   
```

CHART TITLE - SUBROUTINE RAMP

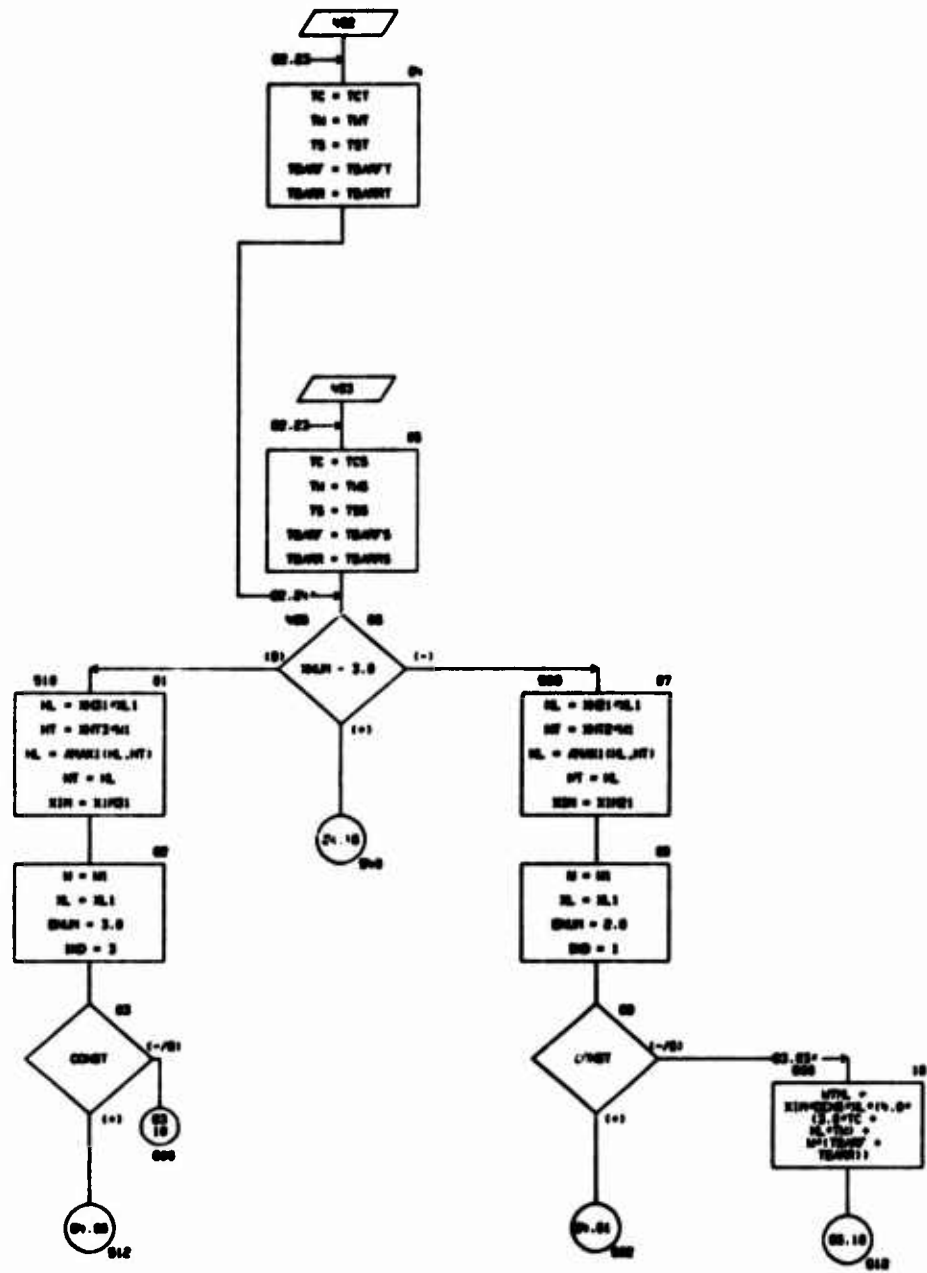


CHART TITLE - SUBROUTINE RAPP

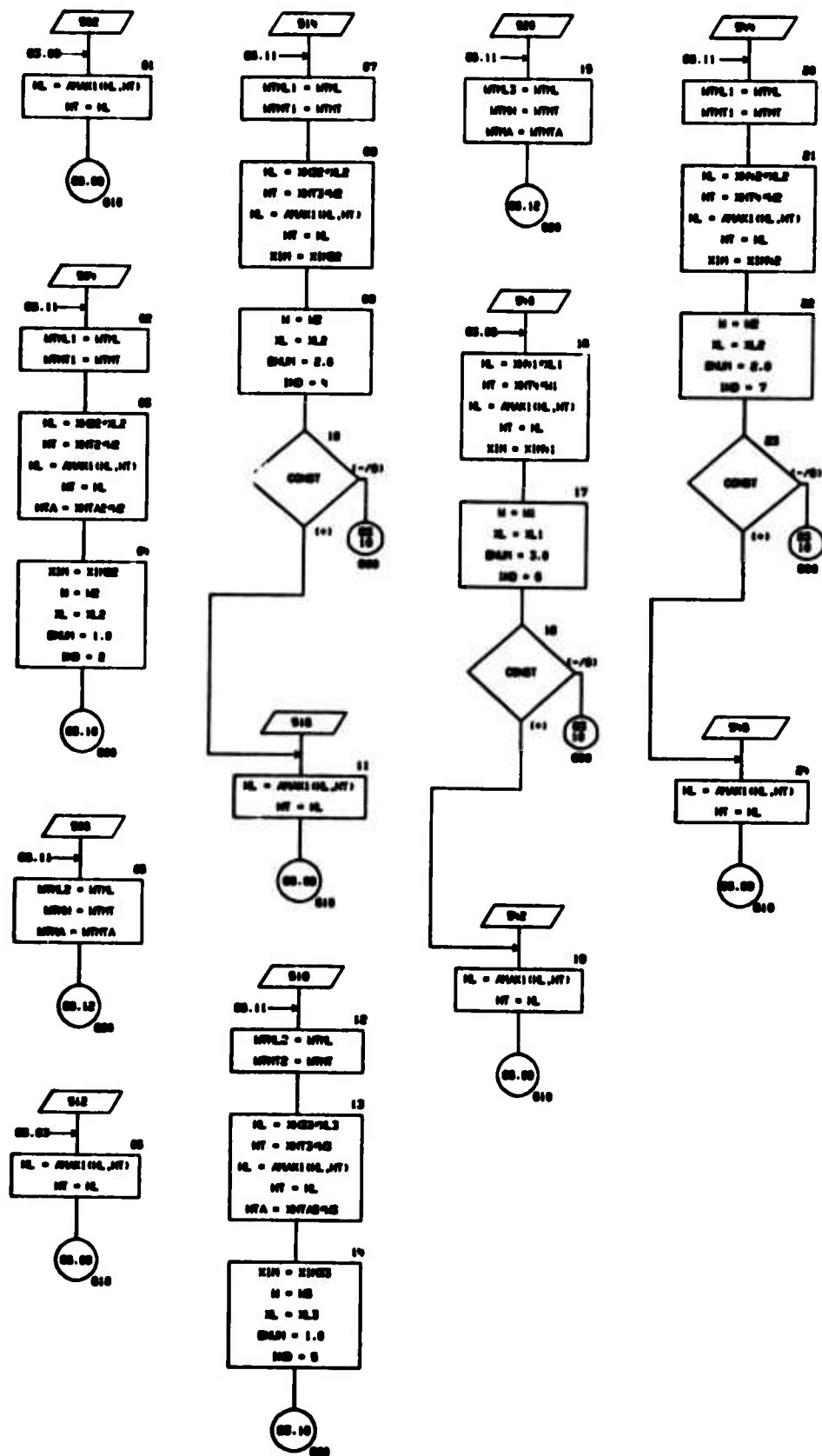
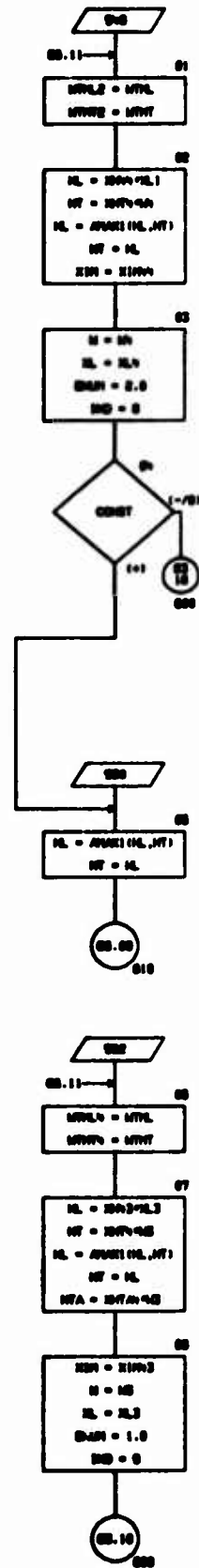


CHART TITLE - SUBROUTINE 0005



```

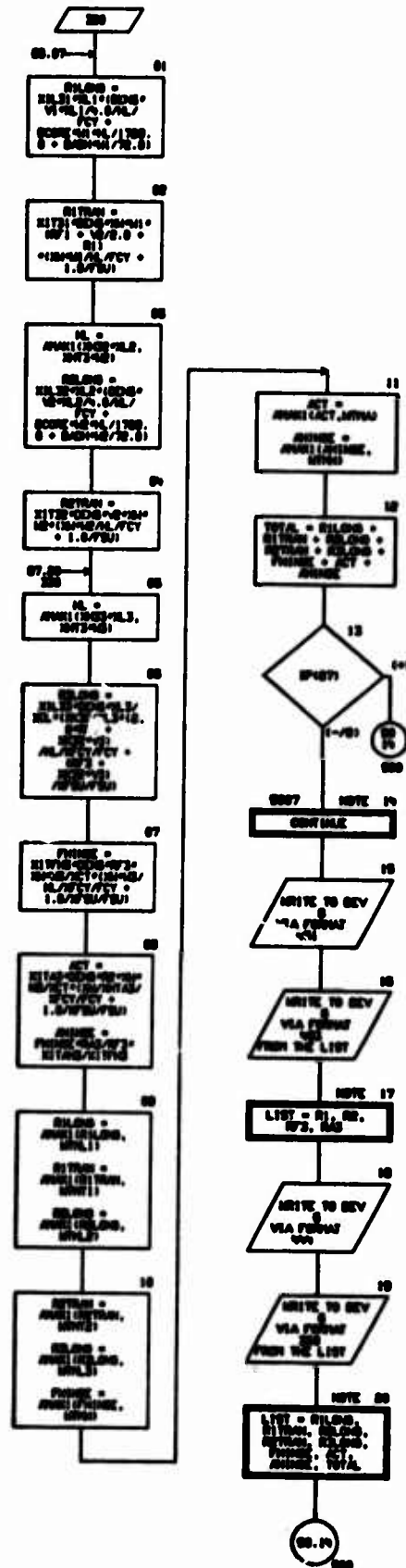
graph TD
    S01[/S01/] --> S02[00.11]
    S02 --> S03[MTVL3 = MTVL  
MTVM = MTVM  
MTVA = MTVA]
    S03 --> S04[010]
    S04 --> S05[00.01]
    S05 --> S06[MTVL = XIM*DEG*H*ALPH  
(2.0*TC + MT*TM)  
.00000*AL*SCORE +  
.0120*GADH)]
    S06 --> S07[00.10]
    S07 --> S08[010]
    S08 --> S09[MTVM = XIM*DEG*H*ALPH  
(2.0*TC + MT*TM)  
MTVA = XIM*DEG*H*ALPH  
(2.0*TC + HT*TM)]
    S09 --> S10[COMPLD GO TO  
FOR 100]
    S10 --> S11[00.02  
00.03  
014  
010  
020  
040  
00.01  
00.00  
00.00]
    S11 --> S12[OUTSIDE THE RANGE  
00.02  
00.00]
    S12 --> S13[NOTE 12  
CONTINUE]
    S13 --> S14{MEAN - 3.0}
    S14 -- (+) --> S15((00.01))
    S14 -- (-) --> S16[000]
    S16 --> S17[P1 = MP01*VMS  
P2 = MP02*VMS]
    S17 --> S18[ALPHAR =  
ALPHAS*.01745329]
    S18 --> S19[V1 = XL1*P1*VMS  
V2 = XL2*P2*VMS]
    S19 --> S20[00  
V1/2, 0/200  
(ALPHAR)  
RA = 00*(1.0 -  
1.0/2000) +  
V2*(1.0 -  
1.0/2.0/2000)  
R = 00/2000 +  
V2/2.0/2000]
    S20 --> S21[XL =  
AMAX(1.0001*XL1,  
R/2000)]
    S21 --> S22{CONST}
    S22 -- (+) --> S23((07.01))
    S22 -- (-) --> S24[000]
    S24 --> S25[R1LMS =  
XIL1*DEG*V1 +  
XIL2*0/200*(1.0/1/  
2.0*0.0/2000/2000 +  
1.0/2000/2000)]
    S25 --> S26[R1TMS =  
XIT1*DEG*V1*V1 +  
XIT2*0/200*(1.0/1/  
2000/2000 +  
1.0/2000/2000)]
    S26 --> S27((07.02))
  
```

```

graph TD
    000([000]) --> 01[01]
    01[01] --> 02[02]
    02[02] --> 03[03]
    03[03] --> 04[04]
    04[04] --> 05[05]
    05[05] --> 06[06]
    06[06] --> 07[07]
    07[07] --> 08[08]
    08[08] --> 09[09]
    09[09] --> 10[10]
    10[10] --> 11[/WRITE TO DEV  
0  
VIA FORMAT  
001/]
    11[/WRITE TO DEV  
0  
VIA FORMAT  
001/] --> 12[/WRITE TO DEV  
0  
VIA FORMAT  
002  
FROM THE LIST/]
    12[/WRITE TO DEV  
0  
VIA FORMAT  
002  
FROM THE LIST/] --> 13[NOTE 13  
LIST = R, RF, RA]
    13[NOTE 13  
LIST = R, RF, RA] --> 14[/WRITE TO DEV  
0  
VIA FORMAT  
003/]
    14[/WRITE TO DEV  
0  
VIA FORMAT  
003/] --> 15[/WRITE TO DEV  
0  
VIA FORMAT  
003  
FROM THE LIST/]
    15[/WRITE TO DEV  
0  
VIA FORMAT  
003  
FROM THE LIST/] --> 16[NOTE 16  
LIST = RILND,  
RITRAN, RILND,  
FINHDE, ACT,  
AHINDE, TOTAL]
    16[NOTE 16  
LIST = RILND,  
RITRAN, RILND,  
FINHDE, ACT,  
AHINDE, TOTAL] --> 17((00.10))
    17((00.10)) --> 000([000])

    01[01] --> 01[01]
    02[02] --> 02[02]
    03[03] --> 03[03]
    04[04] --> 04[04]
    05[05] --> 05[05]
    06[06] --> 06[06]
    07[07] --> 07[07]
    08[08] --> 08[08]
    09[09] --> 09[09]
    10[10] --> 10[10]
    11[/WRITE TO DEV  
0  
VIA FORMAT  
001/] --> 11[/WRITE TO DEV  
0  
VIA FORMAT  
001/]
    12[/WRITE TO DEV  
0  
VIA FORMAT  
002  
FROM THE LIST/] --> 12[/WRITE TO DEV  
0  
VIA FORMAT  
002  
FROM THE LIST/]
    13[NOTE 13  
LIST = R, RF, RA] --> 13[NOTE 13  
LIST = R, RF, RA]
    14[/WRITE TO DEV  
0  
VIA FORMAT  
003/] --> 14[/WRITE TO DEV  
0  
VIA FORMAT  
003/]
    15[/WRITE TO DEV  
0  
VIA FORMAT  
003  
FROM THE LIST/] --> 15[/WRITE TO DEV  
0  
VIA FORMAT  
003  
FROM THE LIST/]
    16[NOTE 16  
LIST = RILND,  
RITRAN, RILND,  
FINHDE, ACT,  
AHINDE, TOTAL] --> 16[NOTE 16  
LIST = RILND,  
RITRAN, RILND,  
FINHDE, ACT,  
AHINDE, TOTAL]
    17((00.10)) --> 17((00.10))
  
```

SUBTITLE - SUBROUTINE RUPP



**CURT TITLE - SHERUTINE RAPS**

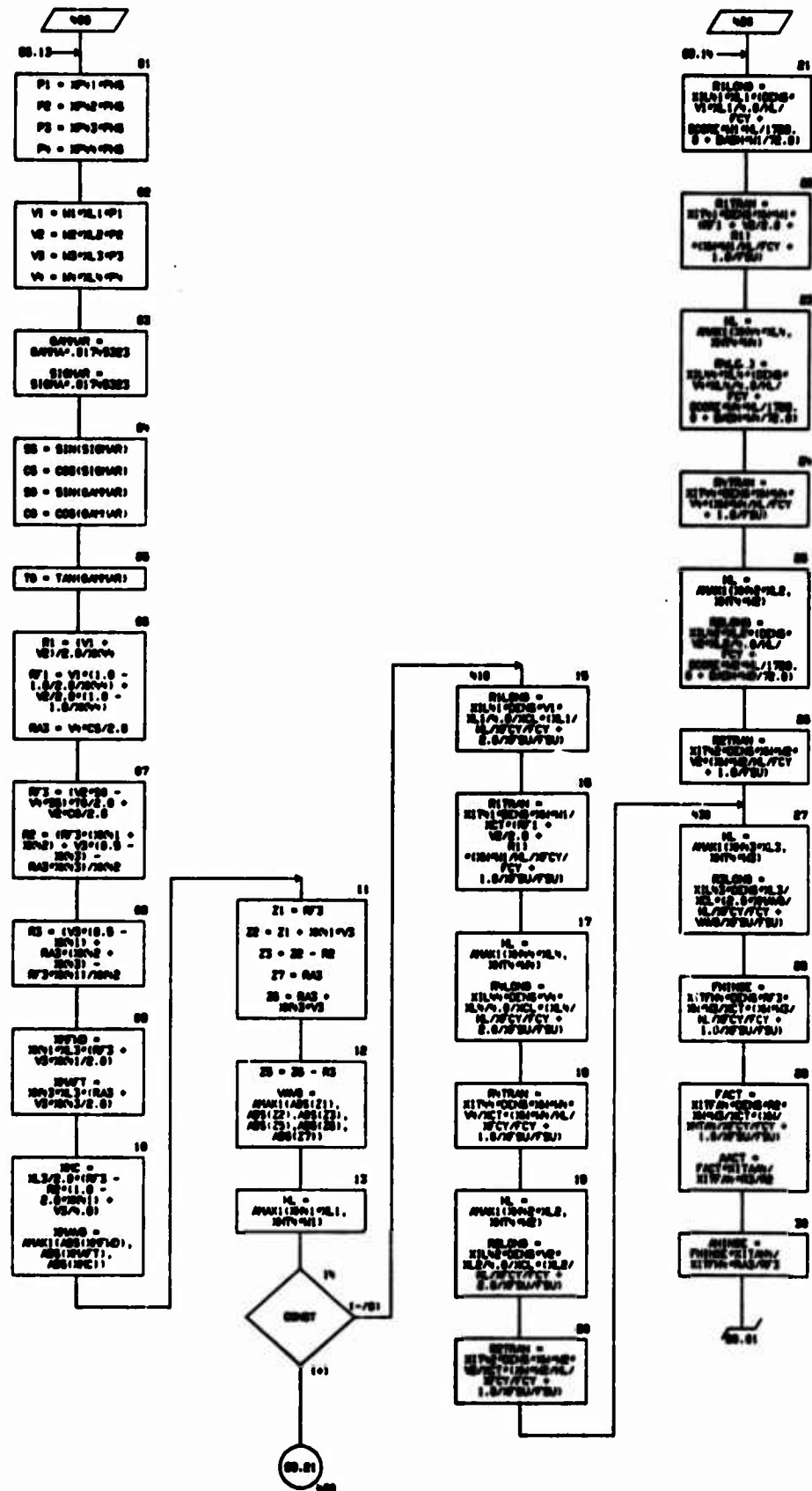
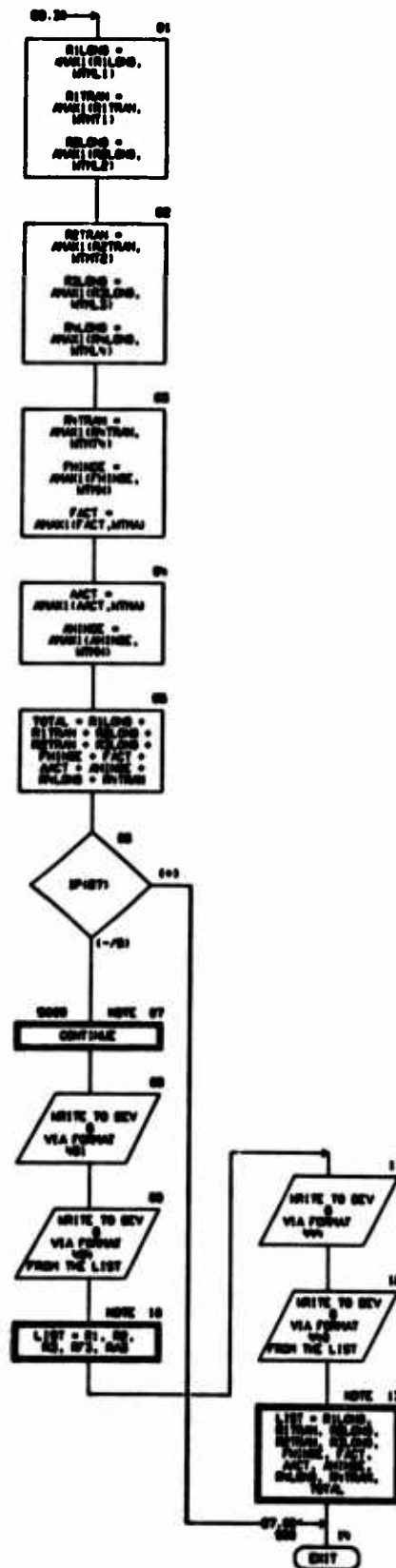


CHART TITLE - SUBROUTINE RAPP



## CURT TITLE - NON-PROCEDURAL STATEMENTS

```

COPEN TCON(400)
COPEN /PRINT/ IP(00)
DIMENSION D(2000), Y(2000), DC(100), ND(200)
DIMENSION F(630), BATR(120), BR(60), TITLE(20)
DIMENSION TOT(100)
EQUIVALENCE (D(1),TCON(1)),(Y(1),TCON(200)),(DC(1),TCON(401)),
              (ND(1),TCON(401))
EQUIVALENCE (BATR(1),D(401)), (BR(1),D(81)),
              (TITLE(1),D(170)), (F(1),D(177))
EQUIVALENCE (XLM ,BATR( 1)), (CNET ,BATR( 2)),
              (PMS ,BATR( 3)), (XL1 ,BATR( 4)), (XL2 ,BATR( 5)),
              (XL3 ,BATR( 6)), (XL4 ,BATR( 7)), (M1 ,BATR( 8)),
              (M2 ,BATR( 9)), (M3 ,BATR(10)), (M4 ,BATR(11)),
              (FCY ,BATR(12)), (FBU ,BATR(13)), (BDS ,BATR(14)),
              (XPA1 ,BATR(15)), (FCT ,BATR(16))
EQUIVALENCE (XEL ,BATR(21)), (FCY ,BATR(22)),
              (FBU ,BATR(23)), (M1 ,BATR(24)), (M2 ,BATR(25)),
              (BDS ,BATR(26)), (CNET ,BATR(27)), (XL1 ,BATR(28)),
              (XIT1 ,BATR(29)), (XIP1 ,BATR(30)), (XIL2 ,BATR(31)),
              (XITW ,BATR(32)), (XITB ,BATR(33)), (XITAB ,BATR(34)),
              (XIP2 ,BATR(35)), (XIP1 ,BATR(36)), (XIP2 ,BATR(37)),
              (XIP1 ,BATR(38)), (XIP2 ,BATR(39)), (XIP1 ,BATR(40)),
              (XIP2 ,BATR(41)), (XIT2 ,BATR(42)), (XITAB ,BATR(43)),
              (ALPMS ,BATR(44)), (XIL3 ,BATR(45)), (XIT3 ,BATR(46)),
              (XIP1 ,BATR(47)), (XIL2 ,BATR(48)), (XIT2 ,BATR(49))
EQUIVALENCE (XIP2 ,BATR(50)), (XIL3 ,BATR(51)),
              (XITW ,BATR(52)), (XITAB ,BATR(53)), (XITAB ,BATR(54)),
              (XIP3 ,BATR(55)), (XIP1 ,BATR(56)), (XIP2 ,BATR(57)),
              (XIP3 ,BATR(58)), (XIP1 ,BATR(59)), (XIP2 ,BATR(60)),
              (XIP3 ,BATR(61)), (XIP1 ,BATR(62)), (XIP2 ,BATR(63)),
              (XIP3 ,BATR(64)), (XIT3 ,BATR(65)), (XITAB ,BATR(66)),
              (ALPMS ,BATR(67)), (XIL4 ,BATR(68)), (XIT4 ,BATR(69)),
              (XIP1 ,BATR(70)), (XIL2 ,BATR(71)), (XIT2 ,BATR(72)),
              (XIP2 ,BATR(73)), (XIL3 ,BATR(74)), (XITW ,BATR(75)),
              (XITW ,BATR(76)), (XITAB ,BATR(77)), (XITAB ,BATR(78))
EQUIVALENCE (XIP3 ,BATR(79)), (XIL4 ,BATR(80)),
              (XIT4 ,BATR(81)), (XIP4 ,BATR(82)), (XIP1 ,BATR(83)),
              (XIP2 ,BATR(84)), (XIP3 ,BATR(85)), (XIP4 ,BATR(86)),
              (XIP1 ,BATR(87)), (XIP2 ,BATR(88)), (XIP3 ,BATR(89)),
              (XIP4 ,BATR(90)), (XIP1 ,BATR(91)), (XIP2 ,BATR(92)),
              (XIP3 ,BATR(93)), (XIP4 ,BATR(94)), (XIT4 ,BATR(95)),
              (XITW ,BATR(96)), (XIP4 ,BATR(97)), (XIP4 ,BATR(98)),
              (TCA ,BATR(99)), (TMA ,BATR(100)), (TBA ,BATR(101)),
              (TBAFA ,BATR(102)), (TBAFA ,BATR(103)), (TCT ,BATR(104)),
              (TMT ,BATR(105)), (TST ,BATR(106)), (TBAFT ,BATR(107)),
              (TBAFT ,BATR(108)), (TCS ,BATR(109)), (TMS ,BATR(110)),
              (TBS ,BATR(111)), (TBAFT ,BATR(112)), (TBAFT ,BATR(113))
EQUIVALENCE (Y(101),TOT(1)),(Y(102),TOTAL),(Y(103),XIL20),
              (TOT(20),XITRAN),(TOT(20),XIL20),(TOT(27),XITRAN),
              (TOT(20),XIL20),(TOT(20),XIL20),(TOT(30),FCT),
              (TOT(31),ACT,ACT),(TOT(32),XIL20),(TOT(33),XIL20),
              (TOT(34),XITRAN)
EQUIVALENCE (ND(113),IPRT), (ND(20),IPAGE)
00  FORMAT(1H),10X,10H,BUILT-IN PARAMETERS,END,END** RAPP - IP(07) **
    / 3
02  FORMAT(10X,10H** 2 RAPP SYSTEM ** )
03  FORMAT(10X,10H** 3 RAPP SYSTEM ** )
04  FORMAT(10X,10H** 4 RAPP SYSTEM ** )
01  FORMAT(1H),10X,10H** MINIMUM DATA **,END,
    END** RAPP - IP(07) **//
101  FORMAT(10X,10H, F10.3 )
10  FORMAT(10X,10H,INPUT DATA//
    10X,NUMBER OF RAPP          ,F10.0/

```

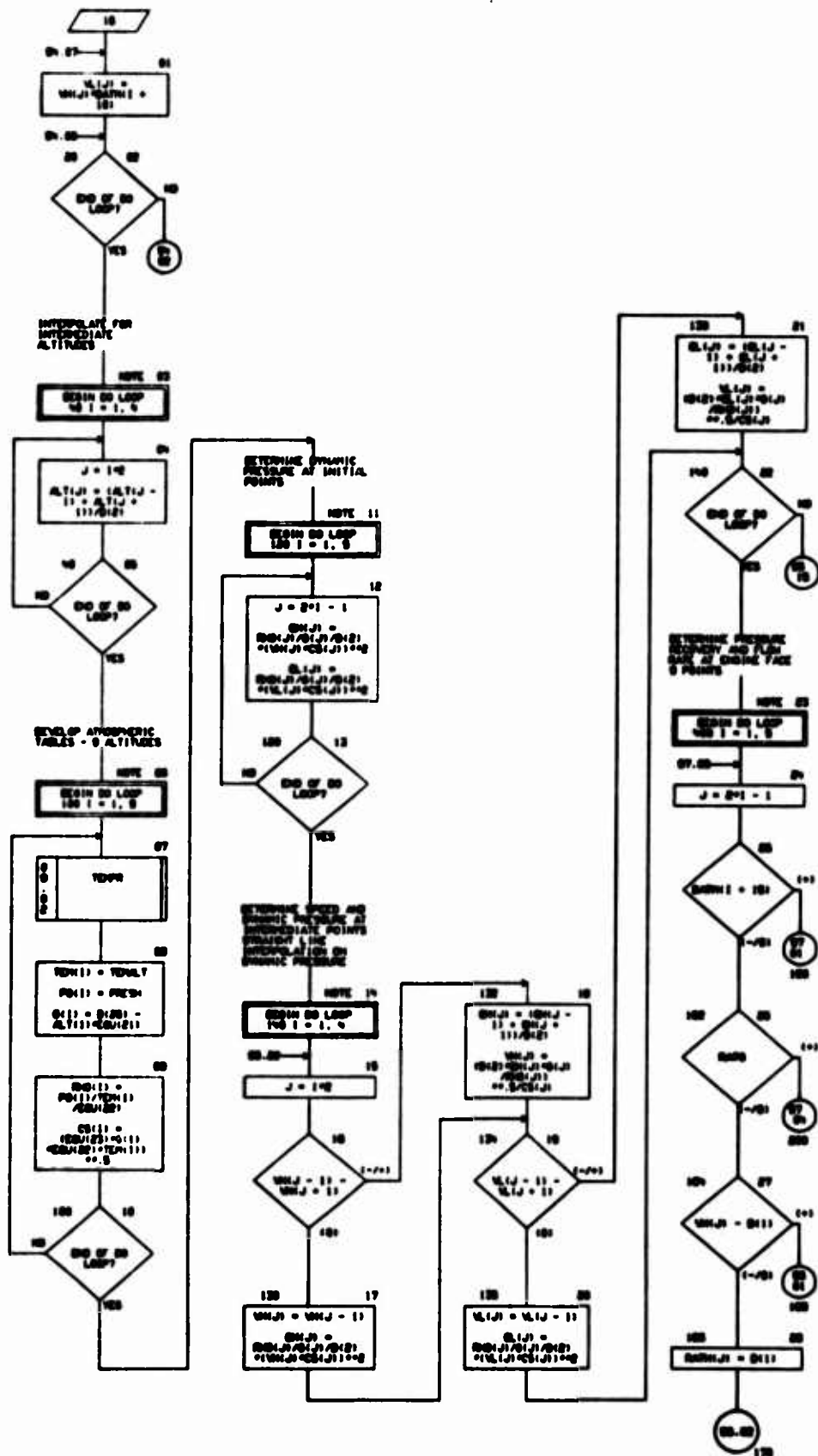


CHART TITLE - INTRODUCTORY COMMENTS

\*\*\*\*\*  
SIGNATURE PAGE  
\*\*\*\*\*

[illegible]

CHART TITLE - SUBROUTINE SPA



[illegible]

CHART TITLE - SUBROUTINE SPA

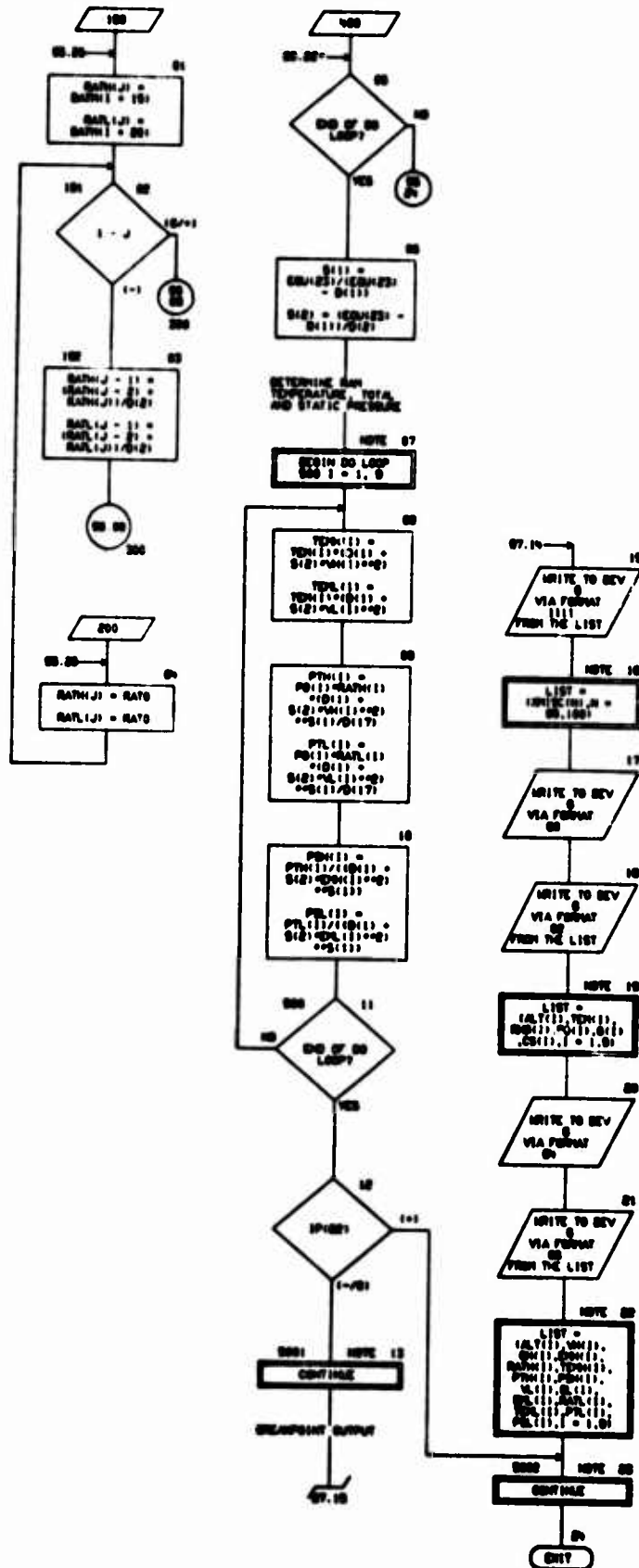




CHART TITLE - INTERLUDE CONTENTS

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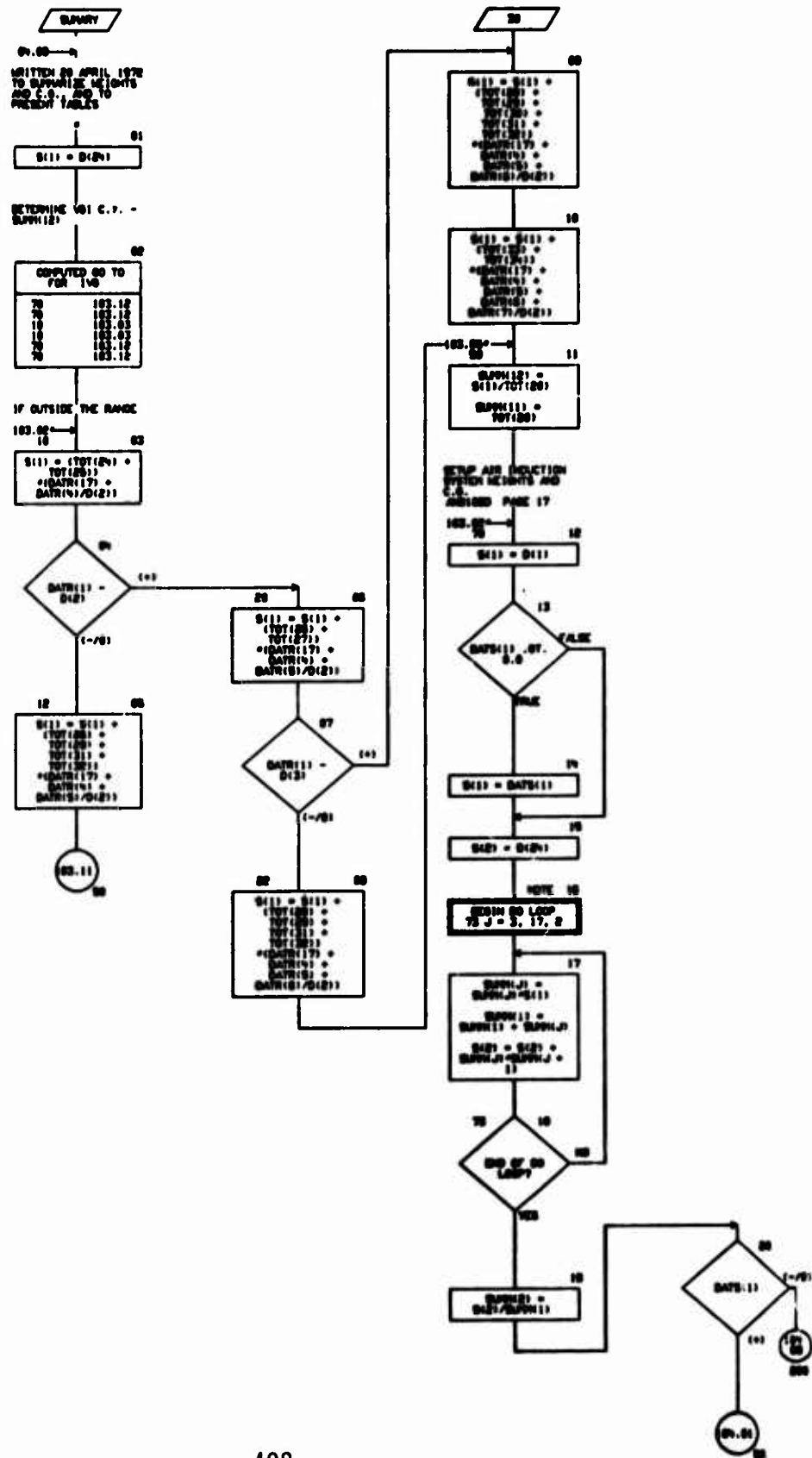
## CHART TITLE - NON-PROCEDURAL STATEMENTS

```
COMMON TCON(400)
DIMENSION B(2000),T(2000),BC(100),NB(200)
DIMENSION CB(200)
DIMENSION BATS(40)
DIMENSION SUPN(200)
DIMENSION S(100)
DIMENSION TOT(100)
EQUIVALENCE (B(1),TCON(1)),(T(1),TCON(2001)),(BC(1),TCON(4101)),
(NB(1),TCON(4201))
EQUIVALENCE (S(0),CB(1))
EQUIVALENCE (S(20),BATS(1))
EQUIVALENCE (S(170),SUPN(1))
EQUIVALENCE (T(1),S(1))
EQUIVALENCE (T(10),TOT(1)),(TOT(30),MFTS),(TOT(30),MFTS),
(TOT(37),MFTS)
EQUIVALENCE (NB(12),IV0)
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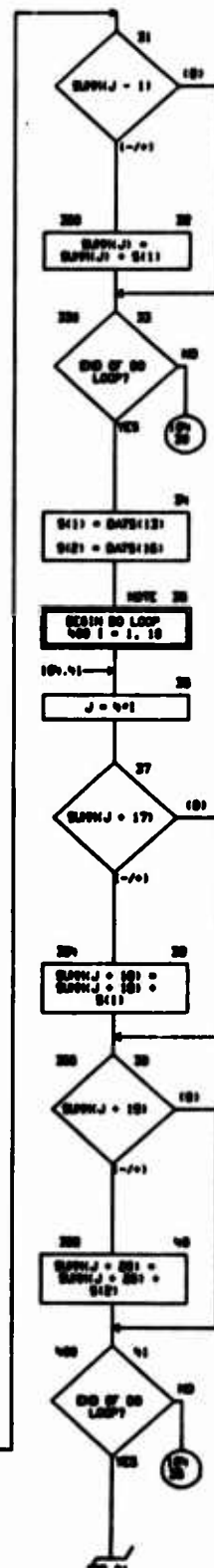
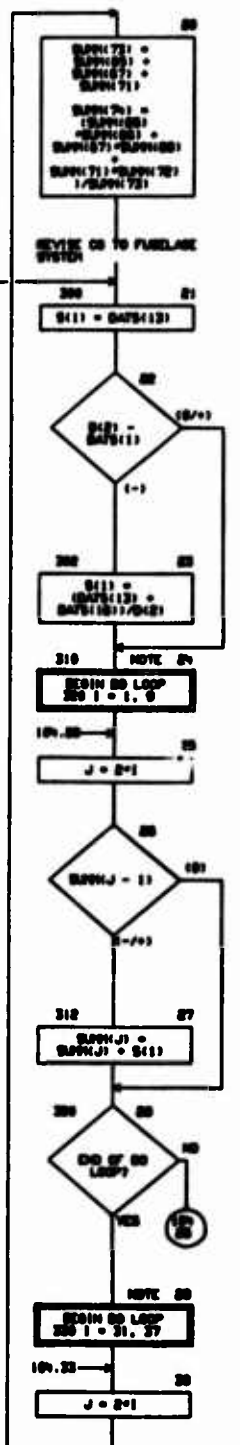
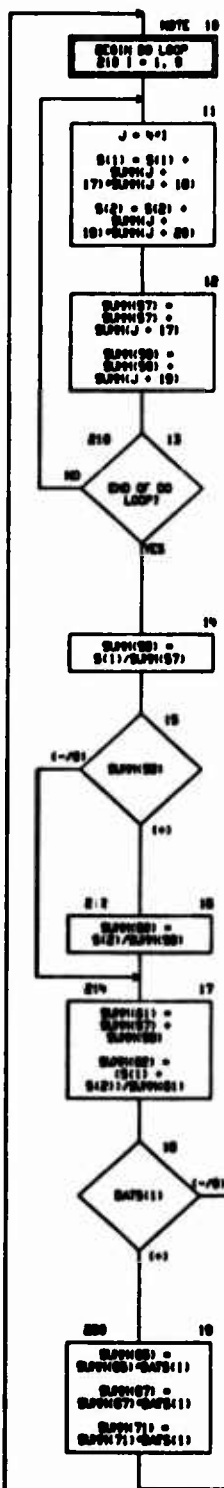
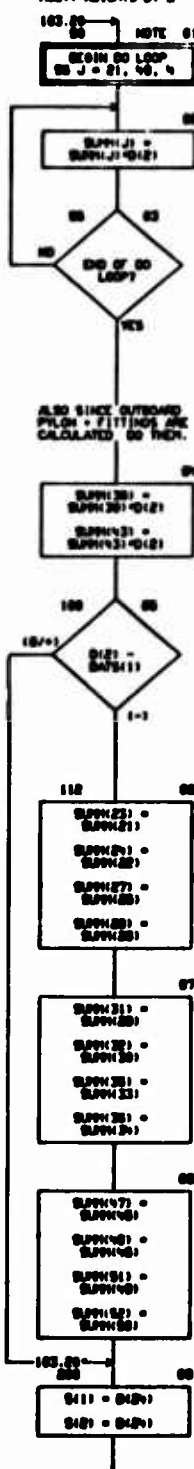
CHART TITLE - INTRODUCTORY COMMENTS

#####  
SUBROUTINE SUMMARY  
#####

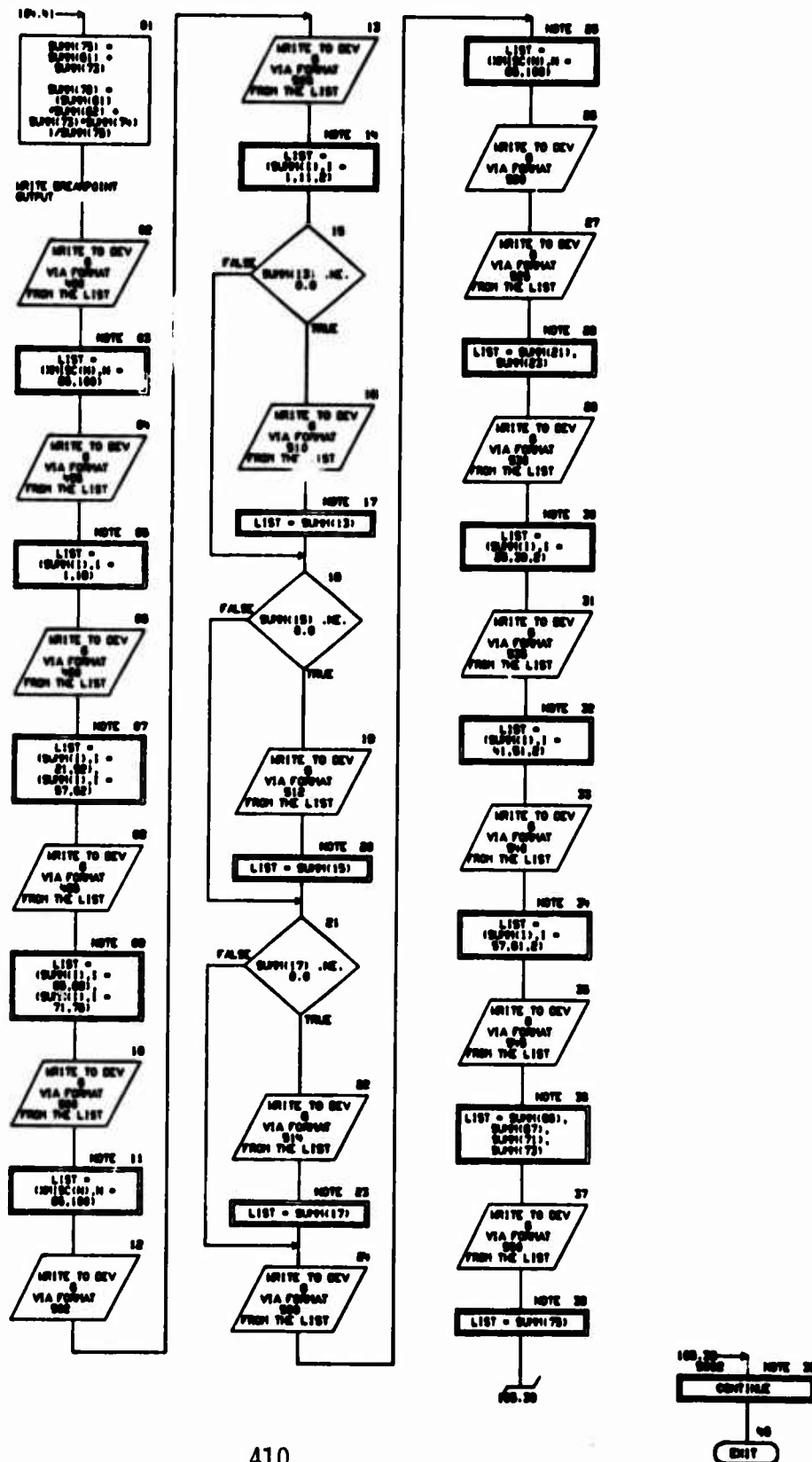
## CHART TITLE - SUBROUTINE SUPPLY



FOR FACILE TYPE  
FALL HEIGHTS BY 2



SHIRT TITLE - SUBROUTINE SUPPLY



## CHART TITLE - NON-PROCEDURAL STATEMENTS

```

      COPEN TCON(400)
      COPEN /HSC/ HSC(100)
      COPEN /PRINT/ IP(00)
      DIMENSION S(2000),T(2000),SC(100),ND(200)
      DIMENSION SATS(40),BATH(100)
      DIMENSION TITLE(20)
      DIMENSION SUPP(200)
      DIMENSION S(100),TOT(100)
      EQUIVALENCE (S(1),TCON(1)),(T(1),TCON(200)),(SC(1),TCON(410)),
      (ND(1),TCON(420))
      EQUIVALENCE (S(20),SATS(1)),(S(40),BATH(1))
      EQUIVALENCE (S(70),TITLE(1))
      EQUIVALENCE (S(170),SUPP(1))
      EQUIVALENCE (T(1),S(1)),(T(101),TOT(1))
      EQUIVALENCE (ND(00),NPAGE)
      EQUIVALENCE (ND(101),1,(ND(100),J)
      EQUIVALENCE (ND(110),100)
      EQUIVALENCE (ND(112),IPRT)
400  FORMAT(1H1,BAIS,17H,10** SUPPLY **/1X,BAIS//
      ENH,57H4. 1. S. * ENGINE SECTION OR NACELLE GROUP HEIGHT * C.G. .
      THUSUPPLY // ENH,5MT.,7H,WC.0.,ENH,5MT.,7H,WC.0. )
450  FORMAT(ENH,5H AIR INDUCTION SYSTEM,T00,BF11.2/ENH,11H INLET MEDGE,
      T00,BF11.2/ ENH,11H AIR DUCTING,T00,BF11.2 /
      ENH,5H INTAKE DOORS * OP. MECHANISM,T00,BF11.2 /
      ENH,5H BYPASS DOORS * OP. MECHANISM,T00,BF11.2 /
      ENH,5H VARIABLE GEOMETRY STRUCTURE,T00,BF11.2 /
      ENH,5H HALF ROUND FIXED SPIKE,T00,BF11.2 /
      ENH,5H FULL ROUND TRANSLATING SPIKE,T00,BF11.2 /
      ENH,5H FULL TRANS. * EXPND. SPIKE,T00,BF11.2 / 1
460  FORMAT(ENH,7H INBOARD,10H,OUTBOARD,10H,ENTOTAL //
      ENH,5MT.,7H,WC.0.,11H,5MT.7H,WC.0.,10H,5MT.7H,WC.0./
      ENH,10H ENGINE MOUNTS,T00,BF11.2,T00,BF11.2/
      ENH,10H BALANCE * FRAMES,T00,BF11.2,T00,BF11.2/
      ENH,5H COVERING * STIFFENERS,T00,BF11.2,T00,BF11.2/
      ENH, 5H COVERING,T00,BF11.2,T00,BF11.2/
      ENH, 5H FITTINGS, T00,BF11.2,T00,BF11.2/
      ENH, 5H PLANS,T00,BF11.2,T00,BF11.2/
      ENH, 5H HEADS,T00,BF11.2,T00,BF11.2 /
      ENH,10H TOTAL ENG SEC./WAC,T00,BF11.2,T00,BF11.2,T00,BF11.2/)
480  FORMAT(ENH,5H ACCESS DOORS,T00,BF11.2 /
      ENH, 10H ENGINE DOORS,T00,BF11.2/ ENH,10H EXTERIOR FINISH,T00,BF11.2/
      ENH,10H TOTAL HSC,T00,BF11.2 //
500  FORMAT(1H1,BAIS,17H,10** SUPPLY **/1X,BAIS)
520  FORMAT(ING,5H,47H * * * P R O P U L S I O N   G R O U P   * * *
      / 5H, 5H----- )
540  FORMAT(ING, 17H, 5H AIR INDUCTION SYSTEM, T00, BF12.2 / ENH,
      11H INLET MEDGE, T00, BF12.2 / ENH, 11H AIR DUCTING, T00, BF12.2 /
      ENH, 5H INTAKE DOORS * OPERATING MECHANISM, T00, BF12.2 /
      ENH, 5H BYPASS DOORS * OPERATING MECHANISM, T00, BF12.2 / ENH,
      5H VARIABLE GEOMETRY STRUCTURE, T00, BF12.2 )
510  FORMAT (1H0, ENH, 5H HALF ROUND FIXED SPIKE, T00, BF12.2 )
512  FORMAT(ING,ENH,5H FULL ROUND TRANSLATING SPIKE,T00,BF12.2)
514  FORMAT (1H0, ENH, 5H FULL TRANSLATING * EXPANDING SPIKE,T00,BF12.2)
520  FORMAT(ING, ENH, 5H ENGINE SECTION OR NACELLE
      LE GROUP. / ENH, 5H-----
      -----, //
      T00,7H INBOARD,T00,5H OUTBOARD,T00,5H TOTAL)
530  FORMAT(ING, 17H, 10H ENGINE MOUNTS, T00, BF12.2 )
540  FORMAT(ING, 17H, 10H NACELLE STRUCTURE / ENH, 10H BALANCE * FRAMES
      T00, BF12.2 / ENH, 5H COVERING * STIFFENERS, T00, BF12.2 /
      ENH, 5H COVERING, T00, BF12.2 / ENH, 5H FITTINGS, T00, BF12.2 )

```

CURT TITLE - NON-PROCEDURE STATEMENTS

```

000  FORMING/IN. 17N. DFFLEN, TOO, W/12.2 / IN. 17N. DFFINELL. TOO,
      W/12.2 / IN. 17N. DFFPDS, TOO, W/12.2 )
040  FORMING/IN. 17N. W/12.2 / IN. 17N. DFFPDS, TOO, W/12.2 )
      TOO, W/12.2 / )
040  FORMING/IN. 17N. DFFPDS + MISCELLANEOUS / IN. DFFPDS / IN.
      DFFPDS, TOO, W/12.2 / IN. DFFPDS, TOO, W/12.2 / IN. 17N.
      DFFPDS + MISCELLANEOUS ..... TOO, W/12.2 )
000  FORMING/IN. 17N. DFFPDS + MISCELLANEOUS ..... TOO, W/12.2 )
      DFFPDS + MISCELLANEOUS ..... TOO, W/12.2 )

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05/05/74

AIRFLOW CHART SET - BEEP

AIR INDUCTION SYSTEM MODULE

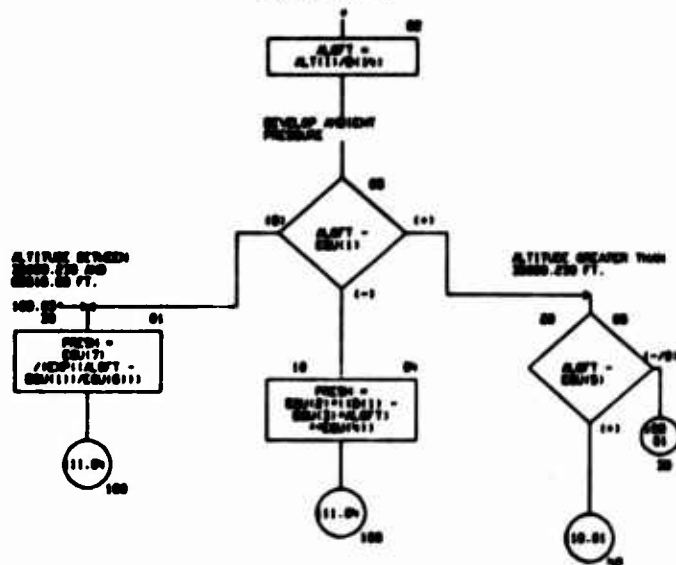
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CHART TITLE - INTRODUCTORY COMMENTS

\*\*\*\*\*  
SUBROUTINE TEST  
\*\*\*\*\*

100-47-10

WRITTEN ON WHICH LOT  
 CONTAINING 75 ACRES  
 SURROUNDING AND  
 ADJACENT TO WOULD BE  
 ACQUIRED BY AN  
 ALIEN OR AN UNLAWFUL  
 ALIEN  
 FOR U.S. PURPOSES  
 SECTION 100-47-10



GURT TITLE - SUBROUTINE T0000

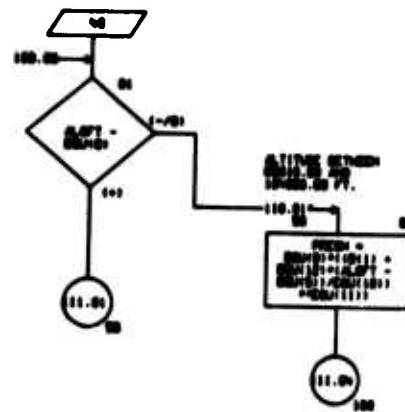


CHART TITLE - SUBROUTINE TUPH

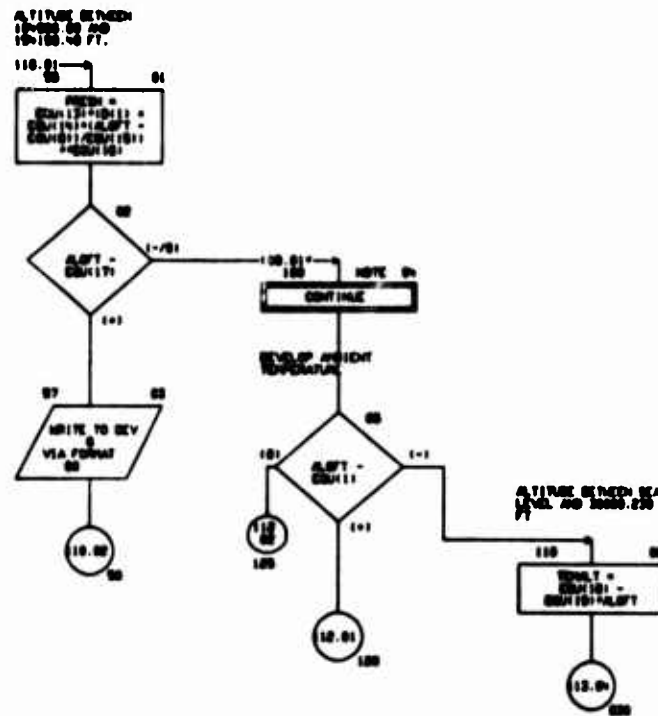
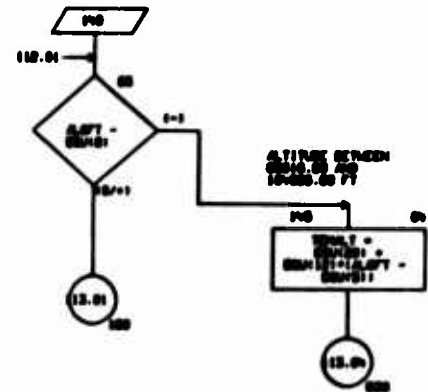
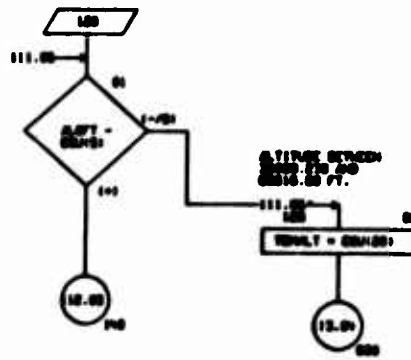
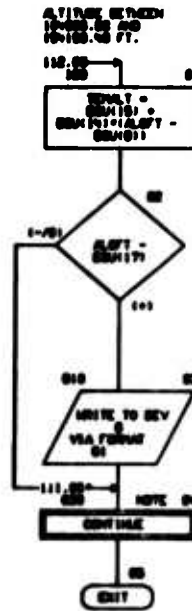


CHART TITLE - SUBMUTINE TOWN



1.4.007 11115 08/00/70 11/07/70



## CHART TITLE - NON-PROCEDURAL STATEMENTS

```

COMMON TCDM400)
DIMENSION D(2000),T(2000),SC(100),AD(200)
DIMENSION SM4000)
DIMENSION S(100)
DO 100 VLENCE (S(1),TCDM(1)),(T(1),TCDM(200)),(SC(1),TCDM(101)),
  (SM(1),TCDM(201))
DO 100 VLENCE (S(1),SM(1))
DO 100 VLENCE (T(1),S(1))
DO 100 VLENCE (S(1),TCDM(1)),(S(2),TCDM(1)),(S(3),TCDM(1))
DIMENSION ALT(10)
DO 100 VLENCE (T(10),ALT(1))
DO 100 VLENCE (SM(10),I)
00  FORMAT(10,S,2000) MARKING MESSAGE ***.ION.
    VOLTAGE IS BEYOND VALID RANGE OF PRESSURE
01  FORMAT(10,S,2000) MARKING MESSAGE ***.ION.
    VOLTAGE IS BEYOND VALID RANGE OF TEMPERATURE

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FORTRAN LISTING  
OF  
AIR INDUCTION SYSTEM MODULE

FORTRAN MODULE (LIST,AUTOGEN)

CARD NO	CONTENTS	****
1	C	
2	C	
3	C	
4	C	
5	C	
6	PROGRAM AIDSM	00010000
7	C ** AIR INDUCTION SYSTEM, NACELLE AND ENGINE SECTION	00010010
8	C CONTROL ROUTINE **	00010020
9	C WRITTEN 22 MARCH 1972	00010030
10	C	00010040
11	COMMON TCOH(400)	00010050
12	COMMON /TISC/2015C(100)	
13	C	
14	COMMON /IPRINT/ IP(80)	
15	C	00010060
16	COMMON /DBATT/ DBAT(80)	
17	C	
18	DIMENSION SUPH(800)	
19	DIMENSION D(2000),T(2000),DC(100),ND(200)	00010070
20	DIMENSION TND(200),JN(20)	00010080
21	DIMENSION BATS(40)	00010090
22	DIMENSION TOT(100)	00010100
23	DIMENSION BATH(120),BR(80)	00010110
24	DIMENSION BARK(10)	00010120
25	DIMENSION F(800)	00010130
26	C	00010140
27	EQUIVALENCE (D(1701),SUPH(1))	
28	EQUIVALENCE (D(1),TCOH(1)),(T(1),TCOH(2001)),(DC(1),TCOH(4101)),	00010150
29	(ND(1),TCOH(401))	00010160
30	EQUIVALENCE (D(201),BATS(1))	00010170
31	EQUIVALENCE (D(401),BATH(1)),(D(401),BR(1))	00010180
32	EQUIVALENCE (D(471),BARK(1))	
33	EQUIVALENCE (D(771),F(1))	00010190
34	EQUIVALENCE (T(101),TOT(1))	00010210
35	EQUIVALENCE (T(1201),TND(1)),(TND(200),JN(1))	00010220
36	EQUIVALENCE (ND(10),JN(10))	00010230
37	EQUIVALENCE (ND(10),JN(10))	00010240
38	EQUIVALENCE (ND(101),JF(1)),(ND(102),JF(2)),(ND(103),JF(3)),(ND(104),JF(4))	00010250
39	EQUIVALENCE (ND(111),JTP(1)),(ND(112),JTV(1))	00010260
40	EQUIVALENCE (ND(113),JPT(1))	00010270
41	C	00010280
42	REMARK 24	
43	C	
44	BUFFER INH(4,1)(TCOH(1),TCOH(400))	
45	C	
46	IF UNIT(4)=1010,1010,1010	
47	C	00010290
48	C CLEAR CASE *** DO NOT EQUIVALENCE 'I' ***	00010370
49	1010 DO 20 I=1,4000	00010380
50	TCOH(I) = 0.0	00010390
51	DO CONTINUE	00010400
52	C	
53	ISML = 1015C(1)	
54	C	
55	C	00010410
56	40 WRITE(6,80)	00010700
57	80 FORMAT(10H)	00010710
58	C.....EJECT PAGE BEFORE CASE DATA IS	00010720
59	C	00010730
60	80 READ NACELLE AND AIS CASE DATA	00010770
61	CALL READS(1,241),2000,20)	
62	C	00010780
63	IF (IP(61))2000,2000,2004	
64	2000 CONTINUE	
65	WRITE(6,100)(IPRINT(10),J=05,100)	
66	1001 FORMAT(10H,20H,20H** AIDSM - IP(61) **/20H,20H/20H,20H)	
67	WRITE(6,1000)	00010800
68	1000 FORMAT(10H, 40H, 20H AIR INDUCTION SYSTEM DATA/)	
69	WRITE(6,1000)(BATH(1),I=1,10)	00010820
70	1000 FORMAT(10H,1000H OF NACELLES, TOT, PB.1 /	00010830

03/29/74	INPUT LISTING	AUTOFLOW CHART SET - SHEEP	AIR INDUCTION SYSTEM MODULE
CARD NO	CONTENTS		
71	1 10X, 10-4 BYPASS RATIO, 102, F10.2 /	00010070	
72	2 27X, 3-4 11-4 FIXED DUCT 2-4 FIXED SPINE1 /	00010080	
73	3 10X, 4-0 INLET TYPE (3-4-0 R12, RAPP 4-0-0 VERT. RAPP 1, 102, F0.1 /	00010090	
74	4 27X, 3-4 11-4-0 TRAMEL SPINE 8-0-0-0 SPINE1 /	00010100	
75	5 10X, 20-0 CAPTURE AREA PER INLET, 102, F10.2 /	00010110	
76	6 10X, 20-0 NUMBER OF INLETS PER AIR VEHICLE, 102, F0.1 /	00010120	
77	7 10X, 4-0-0 DISTANCE OF THROAT FROM L.E. OF COAL OR LIP, 102, F11.3 /	00010130	
78	8 10X, 17-0 NUMBER OF ENGINES, 102, F0.1 /	00010140	
79	9 10X, 17-0 THRUST PER ENGINE, 102, F10.2 /	00010150	
80	A 10X, 17-0 LIGHT PER ENGINE, 102, F11.3 /	00010160	
81	10 10X, 10-0 LENGTH OF ENGINE, 102, F11.3 /	00010170	
82	C 10X, 10-0 DIAMETER OF ENGINE, 102, F11.3 /	00010180	
83	D 10X, 3-0-0 ENGINE C.O., DISTANCE AFT OF FACE, 102, F11.3 /	00010190	
84	E 10X, 2-0-0 AT COAL OR LIP, SET 1, 102, F11.3 /	00010200	
85	F 10X, 2-0-0 AT ENGINE FACE, SET 1, 102, F11.3 /	00010210	
86	G 10X, 2-0-0 AT ENGINE FACE, SET 1, 102, F11.3 /	00010220	
87	H 10X, 2-0-0 AT COAL OR LIP, SET 2, 102, F11.3 /	00010230	
88	I 10X, 2-0-0 AT ENGINE FACE, SET 2, 102, F11.3 /	00010240	
89	J 10X, 2-0-0 AT ENGINE FACE, SET 2, 102, F11.3 /	00010250	
90	WRITE(0,1005) (DATS(1), 1-20, 00)	00010260	
91	1005 FORMAT( 10X, 20-0 NUMBER SHEEP OF PYLON, 102, F10.2 /	00010270	
92	1 10X, 4-0-0 MOUNTING TYPE (0-0-0 VERT, 1-0-0 R12) 10-PYLON, 102, F0.1 /	00010280	
93	2 10X, 30-0-0 CHORD OF INBOARD PYLON, 102, F10.2 /	00010290	
94	3 10X, 30-0-0 CHORD OF OUTBOARD PYLON, 102, F10.2 /	00010300	
95	4 10X, 30-0-0 CHORD OF OUTBOARD PYLON, 102, F10.2 /	00010310	
96	5 10X, 30-0-0 CHORD OF OUTBOARD PYLON, 102, F10.2 /	00010320	
97	A 10X, 30-0-0 PYLON THICKNESS TO CHORD RATIO, 102, F11.3 /	00010330	
98	B 10X, 4-0-0 AUXILIARY INLET AREA PER MACELLE OR AIR VEHICLE,	00010340	
99	C 102, F11.3 /	00010350	
100	D 10X, 4-0-0 DUCT BYPASS AREA PER MACELLE OR AIR VEHICLE, 102, F11.3 /	00010360	
101	WRITE(0,1007) (DATS(1), 1-20, 33), DATS(30), DATS(30), DATS(37)	00010370	
102	* , DATS(1), DATS(2), DATS(3), DATS(4)	00010380	
103	1007 FORMAT( 10X, 27-0 AREA OF MISCELLANEOUS DOORS, 102, F11.3 /	00010390	
104	1 10X, 30-0-0 INDICATOR 10-0-0 1-0-0 YES-CALC, 01 1-0-0-0 AREA),	00010400	
105	2 102, F11.3 /	00010410	
106	3 10X, 20-0 MATERIAL NUMBER FOR DUCTS, 102, F0.1 /	00010420	
107	4 10X, 20-0 MATERIAL NUMBER FOR RAPP, 102, F0.1 /	00010430	
108	5 10X, 20-0 MATERIAL NUMBER FOR MACELLES, 102, F0.1 /	00010440	
109	6 10X, 30-0-0 CHOICE (1-0-0 MIN, 2-0-0 ADD SPD, 3-0-0 ... 4-0-0 MAX, 1,	00010450	
110	7 102, F0.1 /	00010460	
111	8 10X, 20-0 PITCHING ACCELERATION, 102, F11.3 /	00010470	
112	9 10X, 20-0 THERMAL LOAD FACTOR, 102, F10.2 /	00010480	
113	A 10X, 10-0 FACTORS... FACTS-0, F0.2, 3X, 3-0-0-0-0, F0 2, 3X, 3-0-0-0-0,	00010490	
114	B F0 2, 3X, 10-0-0-0-0-0, F0.2 /	00010500	
115	000 CONTINUE		
116	C ..... 00010510		
117	C ** SETUP INDICATORS AND COUNTERS ** 00010520		
118	1TP = DATS(1) 00010530		
119	1V0 = DATS(3) 00010540		
120	C DEVELOP SPEED PROFILE DATA 00010550		
121	IF(DATR(10)) 00, 00, 00		
122	00 IF(DATR(10)) 00, 00, 102		
123	00 CALL SPAL 00010570		
124	CALL MENTLI 00010580		
125	CALL 000P 00010590		
126	07 GO TO (300, 500, 100, 100, 200, 200), 1V0 00010600		
127	C TO READ IN PRESSURES AND LOADS BYPASS PRECIT D(10) MUST BE POSIT		
128	100 IF(DATR(10)) 101, 101, 102		
129	101 CALL PRECIT		
130	102 CALL RAPP		
131	C TO GO RAPP ONLY D(10) MUST HAVE POSITIVE VALUE.		
132	IF(DATR(10)) .07, 0.0) GO TO 1010		
133	C PUT RAPP VALUES IN PER MACELLE (PER A.V. IF INTERNAL) FORM 00010630		
134	T(1) = DATS(5) 00010640		
135	IF(DATR(10)) .07, 0.0) T(1) = DATS(5)/DATS(1) 00010650		
136	TOT(20) = TOT(20) + T(1) 00010660		
137	00 1V0 (0-4, 3) 00010670		
138	1V0 TOT(1) = TOT(1) + T(1) 00010680		
139	00 TO 700 00010690		
140	C 00010700		
141	000 CALL SPINE 00010710		

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03/29/74	INPUT LISTING	AUTOFLEX CHART SET - SHEET	AIR INDUCTION SYSTEM MODULE
CASE NO	****	CONTENTS	****
013	00 FORMAT: WARNING FROM DETECTED IN AIR INDUCTION SYSTEM / 30K.		00120410
014	1 SUBJECT LIP GEOMETRY ERROR		00120430
015	C HORIZONTAL LIP (UPPER L.E.)		00120430
016	20 100 = 2		00120440
017	DATD(1+00) = DATD(1+00)		00120460
018	00 TO 200		00120460
019	100 S(1) = D(1)		00120470
020	S(2) = D(2)*(DATD(1+00) + DATD(1+00)) - DATD(1+00)/		00120480
021	10(10) - D(2)*D(10)		00120490
022	IF(S(2) 101,101,102		00120500
023	101 S(1) = DATD(1+00)/D(2)*DATD(1+00) + D(2)*DATD(1+00)		00120510
024	S(2) = D(2)		00120520
025	C		00120530
026	C ERROR MESSAGE		00120540
027	00 TO 1000		00120550
028	100 S(4) = AMIN(DATD(1+00),DATD(1+00))		00120560
029	S(5) = AMIN(DATD(1+00),DATD(1+00))		00120570
030	IF(S(5) - D(2)*S(2) 100,110,110		00120580
031	100 S(2) = S(5)/D(2)		00120590
032	S(1) = DATD(1+00)/D(2)*(D(10)*S(2) + S(4) - D(2)*S(2))		00120600
033	C		00120610
034	C ERROR MESSAGE		00120620
035	1000 WRITE(6,00) 1, S(1)		00120630
036	00 FORMAT: WARNING FROM DETECTED IN AIR INDUCTION SYSTEM / 14K.		00120640
037	1 THRECTION, 112, 404 IS RECTANGLE OR REDUCED RECT., CORRECTION 1000120650		00120650
038	2 170.3		00120660
039	110 S(6) = (DATD(1+00) - D(2)*S(2))*S(1)/D(2)		00120670
040	S(3) = (DATD(1+00) - D(2)*S(2))*S(1)/D(2)		00120680
041	IF(S(6) 111,112,112		00120690
042	111 S(6) = D(2)		00120700
043	112 IF(S(3) 114,115,115		00120710
044	114 S(3) = D(2)		00120720
045	115 MOD(1) = S(6)		00120730
046	MOD(1) = S(2)*S(1)		00120740
047	MOD(1) = S(3)		00120750
048	SLD(1) = D(2)*MOD(1) + D(10)/D(2)*MOD(1)		00120760
049	SLD(1) = SLD(1)		00120770
050	MOD(1) = D(2)*MOD(1) + D(10)/D(2)*MOD(1)		00120780
051	000 CONTINUE		00120790
052	J = 2		00120800
053	IF(100) 250,250,205		00120810
054	C CALCULATE LEADING EDGE SURFACE		00120820
055	200 J = 3		00120830
056	SLD(1) = DATD(12) - DATD(11)		00120840
057	IF(100-1) 200,200,200		00120850
058	200 IF(DATD(20)) 210,210,200		00120860
059	C SECOND CUT IS OFFSET THEREFORE THERE ARE TWO INLETS PER NACELLE		00120870
060	200 IF(DATD(21)) 207,207,200		00120880
061	C PER VERTICAL LIP CALCULATE LIP, TWO TRIANGLES PLUS VERTICAL MESSAGE		00120890
062	207 SFD(1) = SLD(1)*(DATD(6) + MOD(2)/D(2) + SLD(2) + SLD(2))		00120900
063	00 TO 200		00120910
064	C SPLIT INLET AS PER FUSELAGE MOUNTED		00120920
065	200 SFD(1) = SLD(1)*(DATD(6) + MOD(2) + SLD(2) + SLD(2))		00120930
066	00 TO 200		00120940
067	C THERE IS A SINGLE INLET PER NACELLE		00120950
068	210 SFD(1) = SLD(1)/D(2)*(DATD(6) + SLD(2) + MOD(2) + SLD(2))		00120960
069	00 TO 200		00120970
070	C HORIZONTAL LIP		00120980
071	200 IF(DATD(22)) 204,204,200		00120990
072	C TWO INLETS PER NACELLE		00121000
073	200 SFD(1) = SLD(1)*(DATD(6) + SLD(2) + MOD(2)*D(3)/D(2))		00121010
074	00 TO 200		00121020
075	C ONE INLET PER NACELLE		00121030
076	204 SFD(1) = SLD(1)/D(2)*(DATD(6) + SLD(2) + D(2)*MOD(2))		00121040
077	C CALCULATE SUBSEQUENT SECTIONS OR HERE IF NO L.E.		00121050
078	200 00 200 1-J,JC		00121060
079	SLD(1-1) = DATD(1-10) - DATD(1-0)		00121070
080	S(1) = D(2)		00121080
081	IF(DATD(1+00)) 200,200,200		00121090
082	200 IF(DATD(1+10)) 200,200,200		00121100
083	200 S(1) = D(1)		00121110

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0000      C      FAULT BY PASS RATIO LESS THAN OR EQUAL TO 1.0      00070010
0001      20 REM(1) = (CUM(40) + CUM(41)*5(1) + CUM(42)*5(2) - CUM(43)*5(3))*2 00070020
0002      REL(1) = (CUM(40) + CUM(41)*5(3) + CUM(42)*5(4) - CUM(43)*5(4))*2 00070030
0003      C      CHECK FOR APPLICABILITY OF CURVE      00070040
0004      20 IF(TEMP(1) - CUM(44)) 50,50,50      00070050
0005      30 WRITE(6,50) COTP,TEMP(1),CUM(44)      00070060
0006      40 FORMAT(1H,50H,50H** WARNING MESSAGE **//10H,      00070070
0007      100000 TEMPERATURE EXCEEDED FOR FAULT SPN =,P5.1/10H,      00070080
0008      210000 TEMP =,P5.2,TEMP(1) =,P5.2)      00070090
0009      50 TO 50      00070100
0010      30 IF(50P - CUM(45)) 30,30,40      00070110
0011      C      FAULT SPN G.T. 1.0 BUT L.T. ONE.T. 2.0      00070120
0012      20 REM(1) = (CUM(45) + CUM(47)*5(1) + CUM(48)*5(2) - CUM(49)*5(2))*2 00070130
0013      REL(1) = (CUM(45) + CUM(47)*5(3) + CUM(48)*5(4) - CUM(49)*5(4))*2 00070140
0014      20 IF(TEMP(1) - CUM(50)) 50,50,50      00070150
0015      30 WRITE(6,50) COTP,TEMP(1),CUM(50)      00070160
0016      50 TO 50      00070170
0017      C      FAULT BY PASS RATIO GREATER THAN 2.0      BOTH FACE AND THROAT      00070180
0018      40 REM(1) = CUM(51) - CUM(52)*5(1) + CUM(53)*5(2) - CUM(54)*5(2))*2 00070190
0019      REL(1) = CUM(51) - CUM(52)*5(3) + CUM(53)*5(4) - CUM(54)*5(4))*2 00070200
0020      REM(1) = REM(1)      00070210
0021      REL(1) = REL(1)      00070220
0022      20 IF(TEMP(1) - CUM(55)) 500,500,40      00070230
0023      40 WRITE(6,50) COTP,TEMP(1),CUM(55)      00070240
0024      50 TO 500      00070250
0025      C      50 THROAT HONEYCOMB PRESSURE RATIOS      00070260
0026      50 IF(140 - 2) 50,50,50      00070270
0027      C      FIXED GEOMETRY INLET      140=1 OR 2      00070280
0028      50 IF(14) - CUM(61) 50,50,50      00070290
0029      60 WRITE(6,61) COTP,140,14(1),CUM(61)      00070300
0030      61 FORMAT(1H,50H,50H** WARNING MESSAGE **//10H,      00070310
0031      100000 EXCEEDED FOR ENGINE INLET COMBINATION/50H,      00070320
0032      200000 =,P5.1,2H,15HINLET TYPE =,13,2H,200000 =,P5.2,2H,      00070330
0033      210000 INLET SPEED =,P5.2)      00070340
0034      50 CONTINUE      00070350
0035      C      FOR BY PASS RATIO LESS THAN OR EQUAL TO 2.5      00070360
0036      C      RATIO ENGINE FACE FOR THROAT      (4-21-72)      00070370
0037      REM(1) = (CUM(62) - CUM(63)*5(1) - CUM(64)*5(1))*2 + REM(1)      00070380
0038      REL(1) = (CUM(62) - CUM(63)*5(3) - CUM(64)*5(3))*2 + REL(1)      00070390
0039      C      00070400
0040      C      FAULT BYPASS RATIO GREATER THAN 2.5 THROAT PRESSURE RATIO      00070410
0041      C      SAME AS ENGINE FACE - - - SET-UP THERE.      00070420
0042      C      00070430
0043      500 CONTINUE      00070440
0044      C      00070450
0045      50 210 1=1.0      00070460
0046      PTH(1) = PTH(1)+REM(1)      00070470
0047      PRM(1) = PTH(1)+REM(1)      00070480
0048      PTL(1) = PTL(1)+REL(1)      00070490
0049      REL(1) = PTL(1)+REL(1)      00070500
0050      PST(1) = PTL(1)/REL(1)+REL(1)      00070510
0051      210 CONTINUE      00070520
0052      C      00070530
0053      20 IF(100) 10000,10000,500      00070540
0054      5000 CONTINUE      00070550
0055      WRITE(6,217) 10PISC(1),1000,1000      00070560
0056      217 FORMAT(1H,50H,50H** 000P - 10P(50) **//12,50H)      00070570
0057      WRITE(6,218) COTP, 140      00070580
0058      218 FORMAT(1H,50H, 20-SPD PROFILE DESIGN CONSTANTS,      00070590
0059      1 / 140, 50H, 140SPD RATIO =, P5.2, 50H, 50H10 =, 110 /      00070600
0060      2 140, 40H, 200P(1), 50H, 200STATIC(1), 14H, 140HONEYCOMB (1) /      00070610
0061      3 140, 50H, 12H, 200H, 50H, 140000 RATIO, 50H, 140000 RATIO,      00070620
0062      4 50H, 40FACE, 11H, 200THROAT )      00070630
0063      WRITE(6,221) 14(1), 14(1), 14(1), 14(1), 14(1), 14(1), 14(1), 14(1), 14(1), 14(1)      00070640
0064      221 FORMAT( 5H, 141.1, 1414.2, 1417.3, 1418.4 )      00070650
0065      WRITE(6,222)      00070660
0066      222 FORMAT(1H,40H, 200P(1), 50H, 200STATIC(1), 14H, 140HONEYCOMB (1) /      00070670
0067      1 140, 50H, 12H, 200H, 50H, 140000 RATIO, 50H, 140000 RATIO,      00070680
0068      2 50H, 40FACE, 11H, 200THROAT )      00070690
0069      WRITE(6,223) 14(1), 14(1), 14(1), 14(1), 14(1), 14(1), 14(1), 14(1), 14(1), 14(1)      00070700
0070      WRITE(6,223)      00070710

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DATE	INPUT LISTING	AUTOFLEX CHART SET - SHEET	AIR INDUCTION SYSTEM MODULE
CARD NO	CONTENTS		
007	GO TO 100		00100000
008	100 S(1) = (S(1)) - (S(100)/(1000000) - (S(100)))		00100000
009	C FACTOR FOR PRESSURE FROM THROAT AND BOWING FACE.		00100000
010	100 R(0) = 0.000		00100010
011	100 R(1) = 0.000		00100020
012	100 R(2) = 0.000		00100030
013	GO TO 0-1, 0.00		00100040
014	100 R(3) = 0.000		00100050
015	100 R(4) = 0.000		00100060
016	100 R(5) = 0.000		00100070
017	170 CONTINUE		00100080
018	C		00100090
019	C		00100100
020	GO 000 J-1 0		00100110
021	S(0) = 1.000/0.000		00100120
022	C = AVERAGE PRESSURE FOR 0.00.		00100130
023	C SET UP FOR V SUB M : POINT ON LEVEL FLIGHT LIMIT CURVE		00100140
024	200 FCY = FCY(1,0)		00100150
025	200 FBY = FBY(1,0)		00100160
026	200 FW = FW(1,0)		00100170
027	E = 0.000		00100180
028	S(1) = FCY(1,0) - S(0)		00100190
029	S(2) = FBY(1,0) - S(0)		00100200
030	S(3) = FW(1,0) - S(0)		00100210
031	S(4) = S(1) + S(2) + S(3)		00100220
032	S(5) = S(4) - S(0)		00100230
033	C DIFFERENTIAL PRESSURE = MARGIN + FRAME SPACING		00100240
034	1000 = 1		00100250
035	GO TO 200		00100260
036	C		00100270
037	C SET UP FOR V SUB L HYPERTHROCK (POINT ON MAX. LIMIT CURVE)		00100280
038	200 FCY = FCY(1,0)		00100290
039	200 FBY = FBY(1,0)		00100300
040	200 FW = FW(1,0)		00100310
041	E = 0.000		00100320
042	S(1) = FCY(1,0) - S(0)		00100330
043	S(2) = FBY(1,0) - S(0)		00100340
044	S(3) = FW(1,0) - S(0)		00100350
045	S(4) = S(1) + S(2) + S(3)		00100360
046	S(5) = S(4) - S(0)		00100370
047	1000 = 2		00100380
048	GO TO 200		00100390
049	C		00100400
050	C SET UP FOR V SUB L STATIC (POINT ON MAX. LIMIT CURVE)		00100410
051	200 FCY = FCY(1,0) - S(0)		00100420
052	S(1) = FCY(1,0) - S(0)		00100430
053	S(2) = S(1) + S(2) + S(3)		00100440
054	S(3) = S(2) - S(0)		00100450
055	1000 = 3		00100460
056	C		00100470
057	200 TDE = FCY + P1 + E / 0.12 / (0.11 - FCY) + (0.11 - FCY)		00100480
058	GO 000 0-1, 0.00		00100490
059	1000 = 0.000		00100500
060	1000 = 0.000		00100510
061	1000 = 0.000		00100520
062	1000 = 0.000		00100530
063	1000 = 0.000		00100540
064	1000 = 0.000		00100550
065	1000 = 0.000		00100560
066	1000 = 0.000		00100570
067	1000 = 0.000		00100580
068	1000 = 0.000		00100590
069	1000 = 0.000		00100600
070	1000 = 0.000		00100610
071	1000 = 0.000		00100620
072	1000 = 0.000		00100630
073	1000 = 0.000		00100640
074	1000 = 0.000		00100650
075	1000 = 0.000		00100660
076	1000 = 0.000		00100670
077	1000 = 0.000		00100680
078	1000 = 0.000		00100690
079	1000 = 0.000		00100700
080	1000 = 0.000		00100710
081	1000 = 0.000		00100720
082	1000 = 0.000		00100730
083	1000 = 0.000		00100740
084	1000 = 0.000		00100750
085	1000 = 0.000		00100760
086	1000 = 0.000		00100770
087	1000 = 0.000		00100780

CASE NO	INPUT LISTING	CONTENT	AIR INDUCTION SYSTEM MODULE
000	***	***	00101000
000	TC(1) = TCAP		00101200
000	SC(1) = SC2		00101300
000	CONTINUE		00101400
000	GO TO (200, 240, 280), ICH		00101500
000	CONTINUE		00101600
000	C		00101700
000	MTV = ZER0		00101800
000	MTH = ZER0		00101900
000	MTST = ZER0		00102000
000	DO 510 K=1,177		00102100
000	S(2K) = SB(K)*(THICK) + S(400)		00102200
000	S(2K) = TC(1)*SB(K)*ELSP(K)*400		00102300
000	S(2K) = THICK)*TD*ELSP(K)*400		00102400
000	S(27) = S(2K)*ELSP(K)*400		00102500
000	MTV = MTV + S(2K)		00102600
000	MTH = MTH + S(2K)		00102700
000	MTST = MTST + S(27)		00102800
000	510 CONTINUE		00102900
000	TMT = MTV + MTH + MTST		00103000
000	FRMT(1) = TMT		00103100
000	FRMT(4) = FRMT(1)/SFTH(1)		00103200
000	RETURN		00103300
000	END		00103400
000	C		00103500
000	C		00103600
000	C		00103700
000	C		00103800
000	C		00103900
000	C		00104000
000	C		00104100
000	C		00104200
000	C		00104300
000	C		00104400
000	C		00104500
000	C		00104600
000	C		00104700
000	C		00104800
000	C		00104900
000	C		00105000
000	C		00105100
000	C		00105200
000	C		00105300
000	C		00105400
000	C		00105500
000	C		00105600
000	C		00105700
000	C		00105800
000	C		00105900
000	C		00106000
000	C		00106100
000	C		00106200
000	C		00106300
000	C		00106400
000	C		00106500
000	C		00106600
000	C		00106700
000	C		00106800
000	C		00106900
000	C		00107000
000	C		00107100
000	C		00107200
000	C		00107300
000	C		00107400
000	C		00107500
000	C		00107600
000	C		00107700
000	C		00107800
000	C		00107900
000	C		00108000
000	C		00108100
000	C		00108200
000	C		00108300
000	C		00108400
000	C		00108500
000	C		00108600
000	C		00108700
000	C		00108800
000	C		00108900
000	C		00109000
000	C		00109100
000	C		00109200
000	C		00109300
000	C		00109400
000	C		00109500
000	C		00109600
000	C		00109700
000	C		00109800
000	C		00109900
000	C		00110000

00/00/74	INPUT LISTING	AUTOFLEX CURRY SET - SHEEP	AIR INDUCTION SYSTEM MODULE
CARD NO	****	CONTENTS	****
000	S(3) = PNL(J)		0010040
001	S(4) = DL(J)		0010040
002	S(5) = S(30)		0010040
003	S(6) = S(2)/S(5)		0010040
004	S(7) = S(2)/S(5)		0010040
005	IF(S(7) - S(6)) 310,300,300		0010040
006	310 S(8) = S(7)		0010050
007	300 S(7) = PNL(J) - PDL(J)/D(17)		0010050
008	S(8) = PNL(J) - PDL(J)/D(17)		0010050
009	S(9) = STN(1)*EQU(8)		0010050
010	IF(ND(1) - DATS(8)) 330,330,340		0010050
011	330 S(9) = STN(1)*EQU(8)		0010050
012	C CHECK THICKNESS FOR DEFLECTION CRITERIA		0010060
013	340 S(10) = ABS(S(7) - S(11)*(S(8)-S(7)))		0010060
014	IF(S(10).LT.D(11)) S(10) = D(11)		0010060
015	S(11) = S(10)/S(4)		0010060
016	S(20) = EQU(8)*S(11)*EQU(9)*STN(1)*EQU(8)/S(9)*EQU(8)		0010060
017	IF(S(20) .GT. TC(1)) TC(1) = S(20)		0010060
018	IF(S(20) .GT. TL(1)) TL(1) = S(20)		0010060
019	C CHECK THICKNESS FOR STRENGTH		0010070
020	GO TO 300		0010070
021	C SETUP HAPPERCHECK AT VL		0010070
022	300 K = 2		0010070
023	S(5) = S(40)		0010070
024	S(6) = S(2)/S(5)		0010070
025	S(7) = PNL(J) - PDL(J)/D(17)		0010070
026	S(8) = PNL(J) - PDL(J)/D(17)		0010070
027	S(10) = ABS(S(7) - S(11)*(S(8)-S(7)))		0010070
028	IF(S(10).LT.D(11)) S(10) = D(11)		0010070
029	C CHECK THICKNESS FOR STRENGTH		0010070
030	GO TO 300		0010070
031	C SETUP HAPPERCHECK AT WH		0010070
032	300 K = 3		0010070
033	S(2) = PNL(J)		0010070
034	S(4) = DL(J)		0010070
035	S(5) = S(30)		0010070
036	S(6) = S(2)/S(5)		0010070
037	S(7) = PNL(J) - PDL(J)/D(17)		0010070
038	S(8) = PNL(J) - PDL(J)/D(17)		0010070
039	S(10) = ABS(S(7) - S(11)*(S(8)-S(7)))		0010070
040	IF(S(10).LT.D(11)) S(10) = D(11)		0010070
041	C TEST MID-PANEL		0010080
042	300 S(20) = EQU(8)*STN(1)*S(10)*EQU(8)*S(4)*EQU(8)/		0010080
043	S(5)*EQU(8)		0010080
044	S(21) = EQU(8)*STN(1)*S(10)*EQU(8)*S(4)*EQU(8)/		0010080
045	S(5)*EQU(8)		0010080
046	IF(1MIL) 300,300,300		0010080
047	300 IF(S(21) .GT. S(20)) S(20) = S(21)		0010080
048	IF(S(20) .GT. S(21)) S(21) = S(20)		0010080
049	GO TO 300		0010080
050	300 S(22) = S(21)/EQU(8)		0010080
051	IF(S(22) .GT. S(20)) S(20) = S(22)		0010080
052	IF(S(20) .GT. TC(1)) TC(1) = S(20)		0010080
053	IF(S(20) .GT. TL(1)) TL(1) = S(20)		0010080
054	IF(K - 2) 300,300,400		0010080
055	400 CONTINUE		0010080
056	TOT(3) = TOT(3) + TL(1) - TC(1)*S(40)/STN(1) + TC(1)*DATS(1)*001		0010080
057	RETURN		0010080
058	END		0010080
059	C		
060	C		
061	C SUBROUTINE SUCTS		
062	C		
063	C		
064	C SUBROUTINE SUCTS		0010090
065	C		0010090
066	COMMON TCDN(400)		0010090
067	COMMON /IPRINT/ IP(80)		
068	C		0010090
069	COMMON /MISC/ MISC(100)		
070	C		

00/00/74	INPUT LISTING	AUTOLIN SORT KEY - DEEP	AIR INJECTION SYSTEM SERIAL
CARD NO	****	CONTENTS	****
710	***** 0(000),T(000),JC(100),AD(000)		0010000
711	***** BAR(00)		0010000
712	***** BLN(000)		0010070
713	***** 0(100),TOT(100)		0010000
714	***** TITLE(00), BAR(100)		0010000
715	***** SPIN(00)		0010000
716	***** JED(10),JED(10),JED(10),JED(10),JED(10),JED(10)		0010010
717	***** JLD(10),JED(10),JED(10)		0010000
718	***** TC(10),TL(10),JED(10)		0010010
719	***** JLD(10)		0010000
720	***** TAD(00),TAD(00),JED(00)		0010000
721	***** JED(00),VW(00),JED(00)		0010000
722	C		0010070
723	***** JED(10),TOT(10),T(10),TOT(000),JC(10),TOT(100),		0010000
724	***** JED(10),TOT(000)		0010000
725	***** JED(10),JED(10)		0010000
726	***** JED(10),JED(10), JC(100),TITLE(10)		0010010
727	***** JED(10),JED(10)		0010000
728	***** T(10),0(10),T(100),TOT(10)		0010000
729	***** T(00),JED		0010000
730	***** T(00),JED(10)		0010000
731	***** JED(10),JED(10)		0010000
732	***** T(00),JED(10),T(00),JED(10),T(00),JED(10),		0010070
733	***** JED(10),T(00),JED(10),T(00),JED(10)		0010000
734	***** T(00),JED(10),T(00),JED(10),T(00),JED(10)		0010000
735	***** T(00),TC(10),T(00),TL(10),T(00),JED(10)		0010000
736	***** T(00),JLD(10)		0010000
737	***** JLD(10),JED(10),JLD(10),VW(10),JLD(10),JED(10)		0010000
738	***** T(00),TAD(10),T(00),TAD(10),T(00),JED(10)		0010000
739	***** JED(10),JED(10)		0010000
740	***** JED(10),JED(10)		0010000
741	***** JED(10),JED(10),JED(10),JED(10),JED(10),JED(10)		0010000
742	***** JED(10),JED(10)		0010070
743	***** JED(10),JED(10),JED(10),JED(10),JED(10),JED(10)		0010000
744	***** JED(10),JED(10),JED(10)		0010000
745	***** JED(10),JED(10)		0010000
746	C		0010000
747	JED = JED(10)		0010070
748	JED = JED(10)		0010000
749	JED = JED(10)		0010000
750	JED = JED(10)		0010000
751	JED = JED(10)		0010000
752	JED = JED(10)		0010070
753	JED = JED(10)		0010000
754	JED = JED(10)		0010000
755	JED = JED(10)		0010000
756	JED = JED(10)		0010000
757	JED = JED(10)		0010000
758	JED = JED(10)		0010000
759	JED = JED(10)		0010000
760	JED = JED(10)		0010000
761	JED = JED(10)		0010000
762	JED = JED(10)		0010000
763	JED = JED(10)		0010000
764	JED = JED(10)		0010000
765	JED = JED(10)		0010000
766	JED = JED(10)		0010000
767	JED = JED(10)		0010000
768	JED = JED(10)		0010000
769	JED = JED(10)		0010000
770	JED = JED(10)		0010000
771	JED = JED(10)		0010000
772	JED = JED(10)		0010000
773	JED = JED(10)		0010000
774	JED = JED(10)		0010000
775	JED = JED(10)		0010000
776	JED = JED(10)		0010000
777	JED = JED(10)		0010000
778	JED = JED(10)		0010000
779	JED = JED(10)		0010000
780	JED = JED(10)		0010000

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05/05/74	INPUT LISTING	AUTOFLEX SHORT SET - SHAP	AIR INDUCTION SYSTEM HEADS
CARD NO	CONTENTS		
002	DIVISION (X1000), Y1000, ZC100, J01000		00170070
003	DIVISION (X1000)		00170080
004	DIVISION (X1000), (X1000), (X1000)		00170090
005	DIVISION (X1000), (X1000)		00170100
006	DIVISION (X1000), (X1000), (X1000), (X1000)		00170110
007	DIVISION (X1000), (X1000), (X1000), (X1000)		00170120
008	DIVISION (X1000)		00170130
009	C		00170140
010	REVERSE (X1000), (X1000), (X1000), (X1000), (X1000), (X1000)		00170150
011	REVERSE (X1000)		00170160
012	REVERSE (X1000)		00170170
013	REVERSE (X1000), (X1000), (X1000), (X1000), (X1000)		00170180
014	REVERSE (X1000), (X1000), (X1000), (X1000)		00170190
015	REVERSE (X1000), (X1000)		00170200
016	REVERSE (X1000), (X1000), (X1000), (X1000), (X1000), (X1000)		00170210
017	REVERSE (X1000)		00170220
018	REVERSE (X1000)		00170230
019	REVERSE (X1000), (X1000)		00170240
020	REVERSE (X1000), (X1000), (X1000), (X1000), (X1000), (X1000)		00170250
021	REVERSE (X1000), (X1000)		00170260
022	REVERSE (X1000), (X1000), (X1000), (X1000), (X1000), (X1000)		00170270
023	REVERSE (X1000), (X1000), (X1000), (X1000), (X1000), (X1000)		00170280
024	C		00170290
025	DO TO: 00, 00, 00, 00, 00, 00		00170300
026	C		00170310
027	DO (X1000) = (X1000)		00170320
028	X = (X1000)		00170330
029	DO TO J=1, X		00170340
030	X1000 = (X1000) + (X1000)		00170350
031	DO CONTINUE		00170360
032	X1000 = (X1000) + (X1000)		00170370
033	C		00170380
034	DO J = 2		00170390
035	IF (X1000) 100, 100, 20		00170400
036	DO J = 3		00170410
037	C		00170420
038	REVERSE (X1000)		00170430
039	REVERSE (X1000), (X1000), (X1000)		00170440
040	C		00170450
041	DO TO: 00, 00, 00, 00, 00, 00		00170460
042	X1000 = (X1000)		00170470
043	X1000 = (X1000)		00170480
044	IF (X1000) = 0, 100, 100, 100		00170490
045	C		00170500
046	100 IF (X1000) = (X1000) 100, 100, 100		00170510
047	100 IF (X1000) = (X1000) 100, 100, 100		00170520
048	100 X1000 = (X1000) + (X1000) / (X1000)		00170530
049	100 X1000 = (X1000) + (X1000) / (X1000)		00170540
050	DO TO 100		00170550
051	100 IF (X1000) = 0, 100, 100, 100		00170560
052	C		00170570
053	100 IF (X1000) = (X1000) 100, 100, 100		00170580
054	100 IF (X1000) = (X1000) 100, 100, 100		00170590
055	100 X1000 = (X1000) + (X1000) / (X1000)		00170600
056	100 X1000 = (X1000) + (X1000) / (X1000)		00170610
057	C		00170620
058	100 X1000 = (X1000)		00170630
059	100 IF (X1000) = 0, 100, 100, 100		00170640
060	100 IF (X1000) = 0, 100, 100, 200		00170650
061	100 X1000 = (X1000)		00170660
062	C		00170670
063	100 X1000 = (X1000) + (X1000) / (X1000) / (X1000)		00170680
064	100 X1000 = (X1000)		00170690
065	100 X1000 = (X1000) + (X1000) / (X1000) / (X1000) / (X1000)		00170700
066	100 X1000 = (X1000) + (X1000) / (X1000) / (X1000) / (X1000)		00170710
067	DO TO 400		00170720
068	C		00170730
069	200 X1000 = (X1000) + (X1000) / (X1000) / (X1000) / (X1000)		00170740
070	100 X1000 = (X1000)		00170750
071	400 CONTINUE		00170760
072	RETURN		00170770

DATE	NO	INPUT LISTING	COMMENTS	NO	OUTPUT LISTING
05/03/74	001	001	001	001	001
	002	002	002	002	002
	003	003	003	003	003
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	095	095	095	095	095
	096	096	096	096	096
	097	097	097	097	097
	098	098	098	098	098
	099	099	099	099	099
	100	100	100	100	100

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05/05/74      INPUT LISTING      AUTOFLUX CHART SET - SHEEP      AIR INDUCTION SYSTEM MODULE

CARD NO      ****      CONTENTS      ****

004          DO 70 I=1,177          00140000
005          S(1) = S(1) + (ZP(1) - ZZ5)*-2*SLP(1)          00140000
006          70 CONTINUE          00140070
007          DO 80 J=1,10          00140000
008          V(1) = S(24)          00140000
009          A(1) = S(24)          00140700
010          B(1) = S(24)          00140710
011          80 CONTINUE          00140700
012          DO 90 J=2,10          00140700
013          S(2J) = V(J) - V(J-1)          00140700
014          S(2J) = Z(J) - Z(J-1)          00140700
015          V(1) = V(1) + S(22)          00140770
016          A(1) = A(1) + S(23)          00140700
017          B(1) = B(1) + S(22)*V(1) - V(1-1) + S(23)*Z(1) - Z(1-1)          00140700
018          90 CONTINUE          00140000
019          000 CONTINUE          00140010
020          DO 700 I=1,177          00140000
021          S(27) = (B(1) + B(1-1))/D(2)*SLP(1)          00140030
022          S(30) = S(30) + S(27)          00140040
023          S(31) = S(31) + S(27)*(ZP(1) - ZZ5)          00140050
024          S(32) = S(32) + S(27)*V(1)          00140060
025          700 CONTINUE          00140070
026          B(0) = - S(30)/S(5)          00140000
027          H(0) = - S(31)/S(5)          00140000
028          V(0) = - S(32)/S(7)          00140000
029          DO 800 I=1,177          00140010
030          B(1) = B(0) + V(1)*V(1) + H(0)*(ZP(1) - ZZ5) +          00140000
031          1*(B(1) + B(1-1))/D(2)          00140030
032          S(20) = ((V(1) + V(1)/D(2) + V(0)/D(5))          00140040
033          S(20) = ((A(1) + A(1)/D(2) + H(0)/D(5))          00140050
034          V(1) = S(20)*(V(1) - V(1)) + S(20)*(Z(1) - Z(1))          00140000
035          A(1) = S(20)*(V(1) - V(1)) - S(20)*(Z(1) - Z(1))          00140070
036          800 CONTINUE          00140000
037          C          *** BREAKPOINT OUTPUT ***          00140000
038          IF(I*100)100,00,00          00140010
039          DO WRITE(6,5) L,B(0),H(0),S(2),S(5)          00140010
040          51 FORMAT(1H1,4X,ZH*** DUCT FRAME DATA ***ZK,          00140000
041          1 21H** FRIELD = IP(00) **          /4X,7HECTION,13,          00140000
042          14X,10HANY REDUNDANTS,ZK,B(0) =,F(0.3,ZK,4H0 =,F(0.3,ZK,4H0 =,          00140030
043          8F(0.3,4X,10HOUT PERIMETER =,F(0.3,4X,10HINS PERIMETER =,F(0.3,4X,          00140040
044          21HOUT/INS,2F,14X,10H,EX,B(0),EX,B(0),EX,B(0),EX,B(0),EX,B(0),EX,B(0),          00140000
045          4X,34H0,7F,3-2*0,7X,4H0SLP)          00140000
046          WRITE(6,6) (1,V(1),Z(1),V(1),Z(1),SLP(1),V(1),Z(1),          00140700
047          1V(1),Z(1),SLP(1),I=1,177)          00140000
048          62 FORMAT(10,10F10.3)          00140000
049          00 CONTINUE          00140100
050          RETURN          00140110
051          END          00140100
052          C          00140100
053          C          00140100
054          C          SUBROUTINE FRIEDS          00140100
055          C          00140100
056          C          00140100
057          C          00140100
058          C          SUBROUTINE FRIEDS          00130010
059          C          WRITTEN 20 DECEMBER 1971          00130000
060          C          DEVELOP NODE COORDINATES FOR 61 NODES          00130030
061          C          00130040
062          C          GIVEN TCON(400)          00130000
063          C          00130000
064          DIMENSION S(2000),T(2000),DC(100),H(100)          00130070
065          DIMENSION S(100)          00130000
066          DIMENSION H(210),R(210),Z(210)          00130000
067          DIMENSION V(400),Z(100),SLP(100)          00130100
068          DIMENSION V(61),Z(61)          00130110
069          C          00130100
070          EQUIVALENCE (S(1),TCON(1)),(T(1),TCON(200)),(DC(1),TCON(410)),          00130130
071          (H(1),TCON(400))          00130140
072          C          00130100
073          EQUIVALENCE (V(1),S(1))          00130100
074          EQUIVALENCE (V(61),H(210)),(V(201),R(210)),(V(331),Z(210))          00130170

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03/20/76	INPUT LISTING	AUTOFLEX CHART SET - SHEEP	AIR INJECTION SYSTEM MODEL
CARD NO	****	COMMENTS	001 2
1065	DOUWALDICE (Y(100),Y0(1),Y(102),Y0(1),Y(103),Y0(1))		00130120
1066	DOUWALDICE (Y(100),Y(101),Y(102),Y(103))		00130100
1067	DOUWALDICE (H0(100),J1,H0(103),K1,H0(104),L1,		00130200
1068	I(H0(100),K1)		00130210
1069	DOUWALDICE (H0(110),I0,H0(110),IY?)		00130220
1070	S(2) = 100(L)		00130230
1071	S(3) = 100(L)		00130240
1072	S(4) = 100(L)		00130250
1073	S(1) = S(2) + 0(15)/0(2)*S(3) + S(4)		00130260
1074	S(5) = 10		00130270
1075	S(5) = S(1)/S(5)		00130280
1076	Y(1) = S(24)		00130290
1077	Z(1) = S(3) + S(4)		00130300
1078	S(6) = S(24)		00130310
1079	S(7) = S(24)		00130320
1080	S(8) = S(24)		00130330
1081	I = 2		00130340
1082	IF(S(2)) 100,100,2		00130350
1083	2 S(10) = S(2)/S(5) + 0(1)		00130360
1084	K = INT(S(10))		00130370
1085	IF(K-1) 3,3,4		00130380
1086	3 S(6) = S(2)		00130390
1087	GO TO 100		00130400
1088	4 DO 5 J=1,K		00130410
1089	Y(J) = Y(J-1) + S(5)		00130420
1090	Z(J) = Z(J-1)		00130430
1091	5 CONTINUE		00130440
1092	I = K+1		00130450
1093	S(6) = S(2) - Y(K)		00130460
1094	100 IF(S(3)) 300,300,100		00130470
1095	102 S(6) = S(5) - S(6)		00130480
1096	S(11) = S(3)*0(15)/0(2)		00130490
1097	IF(S(11) - S(6)) 103,103,120		00130500
1098	103 S(6) = S(6) + S(11)		00130510
1099	GO TO 200		00130520
1100	120 S(10) = (S(11) - S(6))/S(5)		00130530
1101	K = INT(S(10))		00130540
1102	IF(K) 123,123,124		00130550
1103	123 S(12) = S(6)/S(3)		00130560
1104	Y(1) = S(2) + S(3)*SIN(S(12))		00130570
1105	Z(1) = S(4) + S(3)*COS(S(12))		00130580
1106	S(6) = S(11) - S(6)		00130590
1107	I = I+1		00130600
1108	GO TO 200		00130610
1109	124 S(12) = S(6)/S(3)		00130620
1110	S(13) = S(12)		00130630
1111	S(14) = S(5)/S(3)		00130640
1112	Y(1) = S(2) + S(3)*SIN(S(12))		00130650
1113	Z(1) = S(4) + S(3)*COS(S(12))		00130660
1114	K = K+1		00130670
1115	I = I+1		00130680
1116	DO 125 J=1,K		00130690
1117	S(13) = S(13) + S(14)		00130700
1118	Y(J) = S(2) + S(3)*SIN(S(13))		00130710
1119	Z(J) = S(4) + S(3)*COS(S(13))		00130720
1120	125 CONTINUE		00130730
1121	I = K+1		00130740
1122	S(6) = (0(15)/0(2) - S(13))*S(3)		00130750
1123	270 IF(S(4)) 300,300,270		00130760
1124	283 S(6) = S(5) - S(6)		00130770
1125	S(10) = (S(4) - S(6))/S(5)		00130780
1126	K = INT(S(10))		00130790
1127	IF(K) 300,300,300		00130800
1128	300 Y(1) = S(2) + S(3)		00130810
1129	Z(1) = S(4) - S(6)		00130820
1130	K = K+1		00130830
1131	I = I+1		00130840
1132	DO 284 J=1,K		00130850
1133	Y(J) = S(2) + S(3)		00130860
1134	Z(J) = Z(J-1) - S(6)		00130870
1135	284 CONTINUE		00130880

05/25/74	INPUT LISTING	AUTOFLOW CHART SET - SHEEP	AIR INJECTION SYSTEM MODULE
CARD NO	CONTENTS		
1135	S(1) = Z(1)		00130000
1137	DO K = 10 + 1		00130000
1138	Y(K) = S(2) + S(3)		00130010
1139	Z(K) = S(24)		00130000
1140	K = 2*10 + 2		00130000
1141	DO 401 I=1,10		00130040
1142	IK = K-I		00130050
1143	Y(IK) = Y(I)		00130000
1144	Z(IK) = -Z(I)		00130070
1145	401 CONTINUE		00130000
1146	K = 2*10 + 1		00130000
1147	DO 402 I=1,10		00131000
1148	IK = I + 1		00131010
1149	Y(IK) = - Y(I+1)		00131020
1150	Z(IK) = - Z(I+1)		00131030
1151	402 CONTINUE		00131040
1152	K = 4*10 + 2		00131000
1153	DO 403 I=1,10		00131000
1154	IK = K-I		00131070
1155	Y(IK) = - Y(I)		00131000
1156	Z(IK) = Z(I)		00131000
1157	403 CONTINUE		00131100
1158	DO 500 I=1,177		00131110
1159	YB(I) = (Y(I) + Y(I+1))/2		00131120
1160	ZB(I) = (Z(I) + Z(I+1))/2		00131130
1161	BLB(I) = ((Y(I+1) - Y(I))*2 + (Z(I+1) - Z(I))*4)*.5		00131140
1162	500 CONTINUE		00131150
1163	RETURN		00131100
1164	END		00131170
1165	C		
1166	C		
1167	C SUBROUTINE MATLF1		
1168	C		
1169	C		
1170	C SUBROUTINE MATLF1		00000110
1171	C MATL PROP. FIT SUB		00000000
1172	C		00000030
1173	C **REVISION-03-21-00-ADD MATL. PROP. TITLE. **		00000040
1174	C REVISION -- 01-11-00 -- NEW LOGIC, LINKAGE, NO PRINT OR MOVE		00000000
1175	C		00000000
1176	C		00000070
1177	C		00000000
1178	C		00000000
1179	C		00000100
1180	C		00000110
1181	C DIMENSION P(2000),T(2000),DC(100),ND(200)		00000120
1182	C DIMENSION TH(100),TH(100),TT(10)		00000130
1183	C		00000140
1184	C EQUIVALENCE (D(1),TCOH(1)),(T(1),TCOH(2001)),(DC(1),TCOH(4101)),		00000150
1185	C (ND(1),TCOH(4201))		00000160
1186	C EQUIVALENCE (T(1001),TH(1)),(T(1001),TH(1)),(T(1001),TT(1))		00000170
1187	C EQUIVALENCE (ND(101),I),(ND(103),K),(ND(104),L),(ND(106),M)		00000180
1188	C		00000190
1189	C		00000200
1190	C		00000210
1191	DO 101 I=1,100		00000200
1192	TH(I) = S(24)		00000230
1193	101 CONTINUE		00000240
1194	C		00000250
1195	C **SETUP FOR INTERPOLATION**		00000260
1196	DO 102 I=1,24		00000270
1197	TH(1+20) = TH(1+110)		00000280
1198	102 CONTINUE		00000290
1199	IF(TH(120)) 31,31,104		00000300
1200	31 IF(TH(100) - TT(2)) 32,130,32		00000310
1201	32 WRITE(6,00) TT(1),TT(2),TH(110)		00000320
1202	00 FORMAT(1X,10X,20X) MATL TEMPERATURE ERROR **//BX,0+MATL NO.,		00000330
1203	07X,1,20X THERE IS NO TEMPERATURE ON FILE,10X,13XEND. TDP. =,		00000340
1204	077,1,2X,13XEND TDP. =,077,1)		00000350
1205	TH(1) = TH(110)		00000360
1206	GO TO 127		00000370

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CARS NO      ****      CONTENTS      ****

1007      104 DO 110 MB=120.275.05
1008      KA = MB - 85
1009      IF (TWO(MB)) 105,105,107
1010      107 IF (TWO(MB)) = TT(2)) 110,105,105
1011      110 CONTINUE
1012      WRITE(6,51) TT(1),TT(2),TWO(MB)
1013      51 FORMAT(////10X,30H*** MATL TEMPERATURE ERROR **/,3X,5HMATL NO.,
1014      105.1,3X,30HTEMPERATURE IS BEYOND RANGE OF TABLE,/10X,
1015      212HREQD. TEMP. =,F7.1,3X,15HLAST TEMP. =,F7.1)
1016      GO TO 105
1017      105 KA = KA - 85
1018      WRITE(6,51) TT(1),TT(2),TWO(KA-85)
1019      105 MB = KA + 85
1020      DO 121 I=1,25
1021      TH(I+24) = TWO(I+KA)
1022      121 TH(I+75) = TWO(I+MB)
1023      TT(3) = (TH(55) - TT(2))/(TH(55) - TH(55))
1024      DO 122 I=1,24
1025      TH(I+20) = TH(I+55) + TT(3)*(TH(I+55) - TH(I+55))
1026      122 CONTINUE
1027      C
1028      C      ***PROCESS BASIC DATA***
1029      120 TH(1) = TT(2)
1030      127 TH(2) = TH(3)
1031      TH(11) = TWO(2)
1032      TH(14) = TWO(3)
1033      TH(15) = TWO(4)
1034      TH(5) = TH(24)/TH(22)
1035      TH(6) = TH(25)
1036      TH(5) = TH(41)/TH(20)
1037      TH(10) = TH(45)
1038      TH(13) = TH(24)
1039      TH(12) = TH(45)
1040      IF (TH(12)) 131,131,132
1041      131 TH(12) = TH(10)
1042      132 TH(10) = TH(47)
1043      IF (TH(10)) 133,133,134
1044      133 TH(10) = TH(12)/2.00
1045      134 TH(17) = TH(45)
1046      IF (TH(17)) 135,135,136
1047      135 TH(17) = 0.12*TH(5)
1048      136 TH(10) = TH(50)
1049      TH(10) = TH(51)
1050      TH(20) = TH(52)
1051      C
1052      C      *FIT DATA N=1 COMP., N= TCH.
1053      140 N = 1
1054      DO 141 I=1,7
1055      TT(I+5) = TH(I+31)
1056      141 CONTINUE
1057      C
1058      142 TT(6) = TT(5)
1059      TT(10) = (TT(10) - TT(5))/2.14
1060      TT(7) = TT(5) + TT(10)
1061      TT(8) = TT(7)+TT(10)
1062      TT(9) = TT(5)+TT(10)
1063      TT(5) = TT(11)/TT(5)
1064      TT(10) = 0.11/TT(5)
1065      TT(17) = TT(10) - TT(10)+TT(10)
1066      C
1067      C      ***DO PT(1,5,5), (1,3,5), (1,4,5)***
1068      143 DO 150 K=1,3
1069      TH(K+15) = 0.124
1070      TT(10) = TT(K+5) - TT(10)+TT(K+11)
1071      TT(10) = TT(10) - TT(K+11)
1072      C
1073      144 TH(K+12) = A.50*(TT(17)/TT(10))/TT(10)
1074      TH(K+100) = EXP(A.50*(TT(10)) - TT(K+11)*TH(K+11))
1075      C
1076      C      SUM OF SQUARES=0
1077      145 TT(20) = 0.11/TT(10) + TH(K+100)*TH(K+112)+EXP(TH(K+112)+TT(1111))00001120

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05/05/74      INPUT LISTING      AUTOFLEX CURT SET - 0400P      AIR INJECTION SYSTEM MODULE

CARD NO      ****      COMMENTS      ****

1340      GO TO 100      00000000
1350      40 WRITE(0,03) 11,PAR1      00000000
1361      100 WRITE(0,100)M01      00000000
1362      100 FORMAT(100,00,0A10/100,0A10)      00000000
1363      C      00000070
1364      107 WRITE(0,110)TM1),TM11),TM2)      00000000
1365      C      00000000
1366      110 FORMAT(100 TEMP,470.0,100 DENSITY=77.4,M FL=77.4,770M      00000000
1367      1      A      0      E      00000010
1368      2      (MRT)      (MRT) 1      00000000
1369      111 FORMAT(100 COMPRESSION 12,0E10.0,0714.1,100 TENSION 100000000      00000000
1370      1,0E10.0,0714.1)      00000000
1371      C      00000000
1372      100 WRITE(0,111)TM3),TM4),TM5),TM10),TM10),TM17),TM10),TM10)      00000000
1373      C      00000070
1374      112 FORMAT(10000      00000000      00000000      00000000      00000000
1375      1      F(1)      F(1)      F(1)      F(1) 1      00000000
1376      113 FORMAT(100 COMPRESSION 12,0712.0,0712.1,100 TENSION 100000000      00000000
1377      1,0712.0,0712.1)      00000000
1378      C      00000000
1379      100 WRITE(0,112)      00000000
1380      121 WRITE(0,113)(TM1-3),1-1,14)      00000000
1381      C      00000000
1382      100 WRITE(0,102)TM12),TM10),TM17)      00000070
1383      122 FORMAT(12300      FTL=70.1,0M FBL=70.1,0M FBL=70.1)00000000
1384      C      00000000
1385      C      00000000
1386      C      **TEMP PRINT**      00000010
1387      200 FORMAT(000 TM)      00000000
1388      201 FORMAT(000 T0)      00000000
1389      202 FORMAT(100 20,12,0E10.0)      00000000
1390      203 WRITE(0,200)      00000000
1391      20 20 N=1,20,0      00000000
1392      K = N + 0      00000070
1393      100 WRITE(0,200)M0,(TM1),1-0,N,1)      00000000
1394      204 CONTINUE      00000000
1395      C      00000070
1396      200 WRITE(0,201)      00000070
1397      200 FORMAT(100 20,12,1070.4)      00000000
1398      20 207 N=10,21,10      00000070
1399      K = N + 0      00000070
1400      100 WRITE(0,200)M0,(TM1),1-0,N,1)      00000070
1401      207 CONTINUE      00000000
1402      C      00000070
1403      C      **EXIT**      00000000
1404      100 RETURN      00000000
1405      END      00000000
1406      C
1407      C (*****
1408      C SUBROUTINE HENTL1
1409      C *****
1410      C
1411      SUBROUTINE HENTL1      00000010
1412      C      00000000
1413      C WRITTEN 21 MARCH 1972      00000000
1414      C      00000000
1415      COMMON TCMH4001      00000000
1416      COMMON /PRINT/ IP4001
1417      C      00000000
1418      DIMENSION D(1000),T(1000),JC(100),JD(200)      00000070
1419      DIMENSION CDM(200)      00000000
1420      DIMENSION TDM(10),TDL(10)      00000000
1421      DIMENSION DMT(40)      00000000
1422      DIMENSION TMD(200),TM(100),TT(20),TMD(100)      00000010
1423      DIMENSION FTM(10),FTL(10),FTM(10),FTL(10),FTM(10),FTL(10),      00000000
1424      FTM(10),FTL(10),JL(10),JLTM(10),FTL(10)      00000000
1425      C      00000000
1426      EQUIVALENCE (D(1),TCMH(1)),(T(1),TCMH(200)),(JC(1),TCMH(410)),      00000000
1427      (JL(1),TCMH(501))      00000000
1428      EQUIVALENCE (D(01),JDM(1))      00000070

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CARD NO	CONTENTS	00000000
1401	J = 0.1	00000000
1402	TIME(J) = TIME	00000000
1403	101 CONTINUE	00000010
1404	IF(11 - 1) 100,100,200	00000020
1405	100 IF(JJ - 1) 102,102,200	00000030
1406	102 IF(IP(63)+2001,0001,200	
1407	0001 CALL RNTLPS	
1408	000 CONTINUE	00000040
1409	200 CONTINUE	00000050
1500	C	00000070
1501	C ***RELEASE POINT OUTPUT***	00000080
1502	IF(IP(64)+310,310,320	
1503	310 WRITE(6,01) 11	00001000
1504	01 FORMAT(1H,2X,20THS REGION PROFILE POINT =,13,00H,	
1505	1 00H** RENTL1 = IP(64) **/)	
1506	00 200 H=1,100,0	00001020
1507	K = H + 4	00001030
1508	WRITE(6,02) H,TIME(1),1-H,K,11	00001040
1509	2 FORMAT(1H 2H,13,00H,0)	00001050
1510	200 CONTINUE	00001060
1511	200 IF4 = 11 + 100	00001070
1512	CALL WRITE(1,TIME(1),100,IF4)	00001080
1513	C	00001090
1514	C SETUP AND STORE DUCT MATERIAL PROPERTIES	00001100
1515	FTM(11) = TIME(12)	00001110
1516	FTM(11) = TIME(10)	00001120
1517	FTM(11) = TIME(10)	00001130
1518	FTM(11) = TIME(12)	00001140
1519	FM(11) = TIME(0)	00001150
1520	FTL(11) = TIME(100)	00001160
1521	FTL(11) = TIME(00)	00001170
1522	FTL(11) = TIME(100)	00001180
1523	FTL(11) = TIME(02)	00001190
1524	EL(11) = TIME(00)	00001200
1525	FTM(11) = TIME(20)	00001210
1526	FTL(11) = TIME(110)	00001220
1527	400 CONTINUE	00001230
1528	END = TIME(11)	00001240
1529	RETURN	00001250
1530	END	00001260
1531	C	
1532	C *****	
1533	C SUBROUTINE MISCON	
1534	C *****	
1535	C	
1536	SUBROUTINE MISCON	00010010
1537	C WRITTEN 17 APRIL 1972	00010020
1538	C TO DEVELOP ENGINE MOUNT AND MISCELLANEOUS BEAR MOUNTS	00010030
1539	C	00010040
1540	COMMON TCON(400)	00010050
1541	C	00010060
1542	DIMENSION D(2000),Y(2000),BC(100),MD(200)	00010070
1543	DIMENSION ED(4000)	00010080
1544	DIMENSION DATS(40),DATD(00),DATW(00)	00010090
1545	DIMENSION SUPP(00)	00010100
1546	DIMENSION S(100),TOT(100)	00010110
1547	DIMENSION MD(10),RED(10),ODM(10)	00010120
1548	DIMENSION MDH(10),RDM(10),ODH(10)	00010130
1549	C	00010140
1550	EQUIVALENCE (D(1),TCON(1)),(Y(1),TCON(2001)),(BC(1),TCON(4101)),	00010150
1551	(MD(1),TCON(4001))	00010160
1552	EQUIVALENCE (D(101),ED(1))	00010170
1553	EQUIVALENCE (D(1001),DATS(1)),(D(1001),DATD(1)),(D(1001),DATW(1))	00010180
1554	EQUIVALENCE (D(170),SUPP(1))	00010190
1555	EQUIVALENCE (Y(1),S(1)),(Y(101),TOT(1))	00010200
1556	EQUIVALENCE (TOT(40),MTDM), (TOT(41),MTAD), (TOT(42),MTDP),	00010210
1557	((TOT(43),MTED), (TOT(47),MTED))	00010220
1558	EQUIVALENCE (TOT(44),MTD), (TOT(45),MTM), (TOT(46),MTD)	00010230
1559	EQUIVALENCE (Y(101),MD(1)),(Y(102),RED(1)),(Y(103),ODM(1))	00010240
1560	EQUIVALENCE (Y(170),MDH(1)),(Y(171),RDM(1)),(Y(172),ODH(1))	00010250
1561	EQUIVALENCE (MD(101),1)	00010260

CARD NO	****	CONTENTS	****
1002		EQUVALENCE (IND(115),NC),IND(123),NCH	00210270
1003	C		00210300
1004		NCH = BATH(1)	00210300
1005		S(1) = BATS(7)	00210300
1006		IF(BATS(1)) 100,100,20	00210310
1007		20 S(1) = BATS(7)/BATS(1)	00210320
1008		100 MTD = EQU(12)*S(1)*BATS(9)	00210330
1009		SUPH(2) = MTD	00210340
1010		SUPH(2) = BATH(10) + BATS(12)	00210350
1011		IF(BATS(27)) 200,200,100	00210360
1012		100 MTA = EQU(13)*BATS(27)	00210370
1013		SUPH(7) = MTA	00210380
1014		SUPH(8) = BATH(10)/D(3)	00210390
1015		200 IF(BATS(28)) 300,300,200	00210400
1016		200 MTP = EQU(14)*BATS(28)	00210410
1017		SUPH(9) = MTP	00210420
1018		SUPH(10) = BATH(10)/D(2)/D(3)	00210430
1019		300 IF(BATS(1)) 400,400,200	00210440
1020	C	ENGINE REVERSAL DOORS - MACELLE	00210450
1021		200 IF(BATH(8)) 400,400,320	00210460
1022		320 S(1) = BATH(10) - BATH(10)	00210470
1023		MTD = EQU(15)*BATH(8)*S(1)/D(17)	00210480
1024		SUPH(67) = MTD	00210490
1025		SUPH(68) = BATH(10) + S(1)/D(2)	00210500
1026		400 IF(BATS(29)) 500,500,420	00210510
1027	C	MISCELLANEOUS DOORS	00210520
1028		400 MTD = BATS(29)*EQU(16)	00210530
1029		SUPH(65) = MTD	00210540
1030		SUPH(65) = BATH(10)/D(2)	00210550
1031		500 IF(BATS(1)) 600,600,500	00210560
1032	C	FIREWALL AT FRONT FACE OF ENGINE MACELLE TYPE ONLY	00210570
1033		500 S(1) = D(1)	00210580
1034		IF(BATH(10)) 500,500,530	00210590
1035		530 S(1) = D(2)	00210600
1036		D(3) = D(2)*(RED(10) + MED(10))	00210610
1037		S(4) = D(2)*(RED(10) + MED(10))	00210620
1038		S(5) = S(3)*S(4) + RED(10)*S(15) - D(4)	00210630
1039	C	INTERPOLATE FOR MACELLE GEOMETRY AT ENGINE FRONT FACE	00210640
1040		I = 1	00210650
1041		D(1) IF(BATH(10) - BATH(10)) 500,500,500	00210660
1042		D(2) I = 1 + 1	00210670
1043		GO TO D(1)	00210680
1044		D(2) S(2) = (BATH(10) - BATH(10))/(BATH(10) - BATH(10))	00210690
1045		S(6) = RED(10) + (RED(10) - RED(10))*S(2)	00210700
1046		S(7) = RED(10) + (RED(10) - RED(10))*S(2)	00210710
1047		S(8) = RED(10) + (RED(10) - RED(10))*S(2)	00210720
1048		S(10) = D(2)*S(4) + S(5)	00210730
1049		S(11) = D(2)*S(4) + S(7)	00210740
1050		S(12) = S(10)*S(11) + S(8)*S(10) - D(4)	00210750
1051		S(13) = S(12) - S(11)*S(5)	00210760
1052		MTP = EQU(17)*S(13)/D(17)	00210770
1053		SUPH(45) = MTP	00210780
1054		SUPH(45) = BATH(10)	00210790
1055	C	EXTERIOR FINISH - MACELLE TYPE ONLY	00210800
1056		MTP = TOT(12)/D(17)*EQU(18)	00210810
1057		SUPH(71) = MTP	00210820
1058		SUPH(72) = BATH(10)/D(2)	00210830
1059	C	SHROUD INDICATOR ZERO NO SHROUD	00210840
1060		IF(BATS(30)) 600,600,500	00210850
1061	C	ENGINE COMPARTMENT SHROUD	00210860
1062		500 S(3) = BATS(30)	00210870
1063	C	IF INDICATOR AREA IS MORE THAN 1.0 VALUE IS AREA, IF NOT O.C. AREA	00210880
1064		IF(BATS(30) - D(1)) 600,600,570	00210890
1065		570 S(4) = BATH(10) + (BATH(10) - BATH(10))*S(2)	00210900
1066		S(5) = BATH(10) - BATH(10)	00210910
1067		S(6) = D(15)*BATS(11) + EQU(19)/D(2) + S(4)	00210920
1068		S(3) = S(1)*S(5)*S(6)/D(17)	00210930
1069		570 MTP = S(3)*EQU(17)	00210940
1070		SUPH(40) = MTP	00210950
1071		SUPH(40) = BATH(10)/D(2) + BATH(10)/D(2)	00210960
1072		600 CONTINUE	00210970

CASE NO	****	CONTENTS	****
1000		RETURN	0010070
1001		END	0010000
1002	C		
1003	C	*****	
1004	C	SUBROUTINE MACLE	
1005	C	*****	
1006	C		
1007		SUBROUTINE MACLE	0010010
1008	C	WRITTEN 7 APRIL 1972	0010000
1009	C	TO DEVELOP MACLE SHELL HEIGHT	0010030
1010	C		0010040
1011		GETEN TCON(400)	0010000
1012		GETEN /PRINT/ IP(00)	
1013	C		0010000
1014		GETEN /HISC/ HISC(100)	
1015	C		
1016		DIMENSION D(2000),T(2000),SC(100),ND(200)	0010070
1017		DIMENSION ECU(100),DATD(00),DATH(00)	0010000
1018		DIMENSION SUPH(000)	0010000
1019		DIMENSION S(100)	0010010
1020		DIMENSION TOT(100)	0010010
1021		DIMENSION TPE(100)	0010010
1022		DIMENSION DATS(40)	0010010
1023		DIMENSION TITL(20), BATH(10)	0010010
1024		DIMENSION ALT(10),VL(10),GL(10)	0010010
1025		DIMENSION SFTH(10),FRTH(10)	0010010
1026		DIMENSION RDN(10),RDN(10),RDN(10),BLN(10),BLN(10)	0010010
1027		DIMENSION RDN(10),BLN(10)	0010010
1028		DIMENSION SFTH(10),RDN(10),RDN(10)	0010010
1029		DIMENSION BLN(10)	0010000
1030		DIMENSION TON(10),SFTH(10),FRTH(10),MTCH(10),MTFH(10)	0010010
1031		DIMENSION MFLH(10)	0010000
1032	C		0010020
1033		DO 1000 I=1,TCOH(10),T(10),TCOH(200),SC(10),TCOH(410),	0010070
1034		100(10),TCOH(400)	0010070
1035		DO 1000 I=1,ECU(10),ECU(10),DATD(10),DATH(10),DATH(10)	0010000
1036		DO 1000 I=1,DATD(10),DATD(10)	0010070
1037		DO 1000 I=1,DATH(10),DATH(10),DATH(10),DATH(10)	0010000
1038		DO 1000 I=1,DATH(10),DATH(10)	0010000
1039		DO 1000 I=1,DATH(10),DATH(10)	0010000
1040		DO 1000 I=1,DATH(10),DATH(10)	0010000
1041		DO 1000 I=1,DATH(10),DATH(10)	0010000
1042		DO 1000 I=1,DATH(10),DATH(10)	0010000
1043		DO 1000 I=1,DATH(10),DATH(10)	0010000
1044		DO 1000 I=1,DATH(10),DATH(10)	0010000
1045		DO 1000 I=1,DATH(10),DATH(10)	0010000
1046		DO 1000 I=1,DATH(10),DATH(10)	0010000
1047		DO 1000 I=1,DATH(10),DATH(10)	0010000
1048		DO 1000 I=1,DATH(10),DATH(10)	0010000
1049		DO 1000 I=1,DATH(10),DATH(10)	0010000
1050		DO 1000 I=1,DATH(10),DATH(10)	0010000
1051		DO 1000 I=1,DATH(10),DATH(10)	0010000
1052		DO 1000 I=1,DATH(10),DATH(10)	0010000
1053		DO 1000 I=1,DATH(10),DATH(10)	0010000
1054		DO 1000 I=1,DATH(10),DATH(10)	0010000
1055		DO 1000 I=1,DATH(10),DATH(10)	0010000
1056		DO 1000 I=1,DATH(10),DATH(10)	0010000
1057		DO 1000 I=1,DATH(10),DATH(10)	0010000
1058		DO 1000 I=1,DATH(10),DATH(10)	0010000
1059		DO 1000 I=1,DATH(10),DATH(10)	0010000
1060		DO 1000 I=1,DATH(10),DATH(10)	0010000
1061		DO 1000 I=1,DATH(10),DATH(10)	0010000
1062		DO 1000 I=1,DATH(10),DATH(10)	0010000
1063		DO 1000 I=1,DATH(10),DATH(10)	0010000
1064		DO 1000 I=1,DATH(10),DATH(10)	0010000
1065		DO 1000 I=1,DATH(10),DATH(10)	0010000
1066		DO 1000 I=1,DATH(10),DATH(10)	0010000
1067		DO 1000 I=1,DATH(10),DATH(10)	0010000
1068		DO 1000 I=1,DATH(10),DATH(10)	0010000
1069		DO 1000 I=1,DATH(10),DATH(10)	0010000
1070		DO 1000 I=1,DATH(10),DATH(10)	0010000
1071		DO 1000 I=1,DATH(10),DATH(10)	0010000
1072		DO 1000 I=1,DATH(10),DATH(10)	0010000
1073		DO 1000 I=1,DATH(10),DATH(10)	0010000
1074		DO 1000 I=1,DATH(10),DATH(10)	0010000
1075		DO 1000 I=1,DATH(10),DATH(10)	0010000
1076		DO 1000 I=1,DATH(10),DATH(10)	0010000
1077		DO 1000 I=1,DATH(10),DATH(10)	0010000
1078		DO 1000 I=1,DATH(10),DATH(10)	0010000
1079		DO 1000 I=1,DATH(10),DATH(10)	0010000
1080		DO 1000 I=1,DATH(10),DATH(10)	0010000
1081		DO 1000 I=1,DATH(10),DATH(10)	0010000
1082		DO 1000 I=1,DATH(10),DATH(10)	0010000
1083		DO 1000 I=1,DATH(10),DATH(10)	0010000
1084		DO 1000 I=1,DATH(10),DATH(10)	0010000
1085		DO 1000 I=1,DATH(10),DATH(10)	0010000
1086		DO 1000 I=1,DATH(10),DATH(10)	0010000
1087		DO 1000 I=1,DATH(10),DATH(10)	0010000
1088		DO 1000 I=1,DATH(10),DATH(10)	0010000
1089		DO 1000 I=1,DATH(10),DATH(10)	0010000
1090		DO 1000 I=1,DATH(10),DATH(10)	0010000
1091		DO 1000 I=1,DATH(10),DATH(10)	0010000
1092	C		0010000
1093		DO 1000 I=1,DATH(10),DATH(10)	0010000
1094		DO 1000 I=1,DATH(10),DATH(10)	0010000
1095		DO 1000 I=1,DATH(10),DATH(10)	0010000
1096	C	ICN=0 = DIRECT FUE FOR ENGINE, -1 = END. TO MACLE. TO SUP.	0010030
1097	C	FOR ICN=1 CALC. LONGERON	0010040
1098	C	BUT ONLY IF 2 END PER MACLE.	0010000
1099		IF ICN .NE. 0 .AND. (DATS(7)/DATS(1)) .LT. 0.01 ICN = 0	0010000
1100		CALL HELD	0010070
1101	C	TEST FOR FLUTTER	0010000
1102		IFLT = 0.0	0010000
1103		DO 100 J=1,0	0010000
1104		IF J = 0	0010010

05/05/74	INPUT LISTING	AUTOFLIGHT SET - SHEEP	AIR INDUCTION SYSTEM MODULE
CARD NO	****	CONTENTS	****
1704	CALL READS(1,THE(1),100,(P4)		00100000
1705	ELM(J) = THE(100)		00100030
1706	IF(VL(J) - 0(1)) 100,10,10		00100040
1707	10 IF(VL(J) - 0(1)) 12,12,00		00100050
1708	C SPEED IS LESS THAN MACH 1.4		00100060
1709	12 S(3) = 0(107) + 0(100)*VL(J)**2 - 0(111)**3		00100070
1710	00 TO 30		00100080
1711	00 IF(VL(J) - 0(2)) 02,02,00		00100090
1712	C SPEED IS GREATER THAN MACH 1.4 BUT LESS THAN 2.0		00100700
1713	00 S(3) = 0(100) - 0(100)*COS(VL(J) - 0(101))*0(10)/0(102)		00100710
1714	MODM(03)*VL(J)**2 - 0(111)**3		00100720
1715	00 TO 30		00100730
1716	C SPEED IS GREATER THAN MACH 2.0		00100740
1717	00 S(3) = VL(J)**2 - 0(111)**3		00100750
1718	20 S(4) = S(3)*ELM(J)/EL(J)		00100760
1719	IF(BATH(7)) 40,40,30		00100770
1720	20 S(5) = BATH(7)*BATH(7)/BATH(7)		00100780
1721	IF(S(4) - 0(5)) 40,40,100		00100790
1722	40 BATH(7) = VL(J)		00100800
1723	BATH(7) = ALT(J)		00100810
1724	BATH(7) = EL(J)		00100820
1725	BATH(7) = S(3)		00100830
1726	BATH(7) = ELM(J)		00100840
1727	WLT = J		00100850
1728	100 CONTINUE		00100860
1729	WLEN = THE(101)		00100870
1730	00 110 1=1,LEN		00100880
1731	TON(1) = 0(102)		00100890
1732	110 CONTINUE		00100900
1733	C SETUP FRAME SPACING		00100910
1734	100 00 200 1=1,LEN		00100920
1735	IF(BATH(1+0) - BATH(10+0)) 120,120,100		00100930
1736	C NOELLE STATION IS FORWARD OF ENGINE FACE		00100940
1737	120 IF(1 - 1) 120,120,140		00100950
1738	120 IF(100) 120,120,200		00100960
1739	120 WTON(1) = WTON(1)		00100970
1740	FROM(1) = FROM(1)		00100980
1741	IF(BATH(2)) 200,200,127		00100990
1742	127 FROM(1) = FROM(1)*0(2)		00101000
1743	00 TO 200		00101010
1744	140 J = 1		00101020
1745	140 IF(BATH(J+0) - BATH(1+0)) 142,144,144		00101030
1746	142 J = J + 1		00101040
1747	00 TO 141		00101050
1748	144 S(2) = 0(1)		00101060
1749	S(3) = 0(1)		00101070
1750	IF(BATH(J+0)) 146,146,146		00101080
1751	146 S(3) = S(2)		00101090
1752	146 IF(BATH(J+0)) 146,146,147		00101100
1753	147 S(2) = S(2)		00101110
1754	146 S(3) = 0(104+0) - BATH(1+0)/BATH(J+0) - BATH(J+0)		00101120
1755	WTON(1) = WTON(J) + (WTON(J+1) - WTON(J))*S(1)		00101130
1756	FROM(1) = FROM(J+0+0) - S(1)*S(2) + FROM(J+1)*S(1)*S(2)		00101140
1757	00 TO 200		00101150
1758	C SECTION AFT OF ENGINE FACE		00101160
1759	100 WTON(1) = BATH(0)		00101170
1760	S(1) = BATH(1+00) - BATH(0)		00101180
1761	FROM(1) = 0(4)*0(100)*0(57) + BATH(7)*0(100)*S(1)*0(50)		00101190
1762	C TEST FOR FLUTTER		00101200
1763	200 IF(WLT) 200,200,210		00101210
1764	210 S(4) = WTON(1)/FROM(1)		00101220
1765	IF(S(4) - 0(4)) 211,210,212		00101230
1766	211 S(4) = 0(101)		00101240
1767	212 S(2) = 0(104) - 0(100)*S(4) + 0(100)*S(4)**2 - 0(107)*		00101250
1768	10(4)**3		00101260
1769	S(5) = 0(104)*BATH(7)/BATH(7)*0(171)*0(21)		00101270
1770	S(5) = S(2)*WTON(1)/S(5)		00101280
1771	IF(WTON(1) .LT. 0(5)) TON(1) = S(5)		00101290
1772	C CALCULATE MOMENTS		00101300
1773	200 IF(1 - 1) 200,200,202		00101310
1774	202 IF(1 - 0) 204,204,200		00101320

05/05/76	INPUT LISTING	AUTOFLOW CHART SET - DEEP	AIR INDUCTION SYSTEM MODULE
CARD NO	*****	CONTENTS	*****
1775	200 IF (ICH) 200,200,200		00101200
1776	200 MTCH(1) = S(2)		00101200
1777	MTWN(1) = S(2)		00101200
1778	C PER VERTICAL LIP WITH LONGERON		00101200
1779	IF (ICH) 200, 1, AND, ICH 200, 1, 00 TO 200		00101270
1780	00 TO 200		00101200
1781	C TEST FOR LOCATION		00101200
1782	200 IF (BATH(1)-B) - BATH(1) 200,200,200		00101400
1783	C SECTION FORWARD OF ENGINE FACE		00101410
1784	200 MTCH(1-1) = (TCH(1)-BATH(1-00)) * TCH(1-1)-BATH(1-00)/S(2)		00101400
1785	SLDN(1-1)=0EN		00101430
1786	00 TO 200		00101440
1787	C SECTION AFT OF ENGINE FACE		00101400
1788	200 S(1) = BATH(1-00) - BATH(0)		00101400
1789	S(2) = BATH(1-00) - BATH(0)		00101470
1790	MTCH(1-1) = (TCH(1)-S(1)) * TCH(1-1)-S(2)/S(2)+SLDN(1-1)=0EN		00101400
1791	C CALCULATE FRAMES		00101400
1792	200 MTWN(1-1)=IF (TCH(1)/S(1)) * F(100(1-1)/S(1)) + S(2) * SLDN(1-1)=00101500		
1793	IF (ICH) 200,200,200		00101510
1794	C ONLY CALC. IF 2 ENDS PER MAC		00101520
1795	200 MFLN(1-1) = SLDN(100(1)-BATH(1-20)+BATH(1-00)/S(2)+SLDN(1-1)/S(1)=00101530		
1796	MFLN(1-1) = MFLN(1-1)+BATH(1)		00101540
1797	200 CONTINUE		00101550
1798	J = NCH - 1		00101560
1799	S(1) = S(2)		00101570
1800	S(2) = S(2)		00101580
1801	S(3) = S(2)		00101590
1802	00 200 I=1,J		00101600
1803	MTCH(1) = MTCH(1)+BATH(2)		00101610
1804	MTWN(1) = MTWN(1)+BATH(2)		00101620
1805	TOT(12) = TOT(12) + S(1)		00101630
1806	TOT(20) = TOT(20) + MTCH(1)		00101640
1807	TOT(30) = TOT(30) + MTWN(1)		00101650
1808	TOT(22) = TOT(22)+MFLN(1)		00101660
1809	S(1) = S(1) + MTCH(1)*BATH(1-10) + BATH(1-11)/S(2)		00101670
1810	S(2) = S(2) + MTWN(1)*BATH(1-10) + BATH(1-11)/S(2)		00101680
1811	S(3) = S(3) + MFLN(1)*BATH(1-10)+BATH(1-11)/S(2)		00101690
1812	200 CONTINUE		00101700
1813	SLPH(25) = TOT(30)		00101710
1814	SLPH(26) = TOT(30)		00101720
1815	SLPH(33) = TOT(22)		00101730
1816	SLPH(28) = S(2)/SLPH(25)		00101740
1817	SLPH(30) = S(1)/SLPH(26)		00101750
1818	IF (ICH) 200, 0, 0 SLPH(34)=S(3)/SLPH(33)		00101760
1819	IF (IP(70)) 2001,2001,2002		
1820	2001 CONTINUE		
1821	C *** BREAKPOINT OUTPUT ***		00101770
1822	WRITE(0,001)N(1:CH),N=05,100		00101780
1823	00 FORMAT(1H1,BA10,EN,2(1H** MACELLE - IP(70) **),1X,BA10)		
1824	WRITE(0,01) 1EN,NCH		00101810
1825	01 FORMAT(1H2,2X,20(1H** MACELLE GEOMETRY - SECTION DATA **),		00101820
1826	1 /37H,10ALIP TYPE =,13,4X,10HSHAPE CODE =,13/EN,		00101830
1827	20HOUT,2X,4HSTA,2X,2HDEPTH,2X,2H10TH,4X,4HAPER,2X,2H00,EN,		00101840
1828	20H00,EN,2H40,EN,2H00,EN,2H00,EN,2H00,EN,2H00,EN,2H00,EN,		00101850
1829	WRITE(0,02) (1,BATH(1-10),BATH(1-40),BATH(1-00),BATH(1-00),		00101860
1830	10EN(1),20EN(1),NCH(1),SLN(1),SLN(1),0EN(1),20EN(1),20EN(1),1=1,NCH=00101870		
1831	02 FORMAT(17,10F3.1)		00101880
1832	WRITE(0,03)		00101890
1833	03 FORMAT(17,2X,2HOUT,4X,4HSTA,4X,2H00,SP,2X,2H00,MT,2X,2HCOVER)		00101900
1834	WRITE(0,04) (1,BATH(1-10),S(1),F(100(1)),TCH(1),1=1,NCH)		00101910
1835	04 FORMAT(2X,17,3F3.2,F3.4)		00101920
1836	WRITE(0,05)		00101930
1837	05 FORMAT(17,2X,2H00,4X,2HSLDTH,2X,4HAPER,2X,2H00 COVER,4X,2H00 FR,20101940		
1838	= 2X,10HAT LONGERON )		00101950
1839	J = NCH - 1		00101960
1840	WRITE(0,06) (1,SLDN(1),S(1),MTCH(1),MTWN(1),MFLN(1),1=1,J )		00101970
1841	06 FORMAT(2X,17,5F11.2)		00101980
1842	WRITE(0,07) BATH(1-10),TOT(12),TOT(20),TOT(30),TOT(22)		00101990
1843	07 FORMAT(2X,5H00AL,5F11.2)		00102000
1844	C *** EXIT ***		00102010
1845	2002 CONTINUE		

00/00/74	INPUT LISTING	AUTOFLEX DUST SET - SHCOP	AIR INDUCTION SYSTEM MESSAGE
CARD NO	****	COMMENTS	****
1046	RETURN		00100000
1047	END		00100000
1048	C		
1049	C	ROUTINE RELEASE	
1050	C	ROUTINE RELEASE	
1051	C	ROUTINE RELEASE	
1052	C	ROUTINE RELEASE	
1053	C	ROUTINE RELEASE	00100010
1054	C	ROUTINE RELEASE	00100000
1055	C	ROUTINE RELEASE	00100000
1056	C	ROUTINE RELEASE	00100000
1057	C	ROUTINE RELEASE	00100000
1058	C	ROUTINE RELEASE	00100000
1059	C	ROUTINE RELEASE	00100000
1060	C	ROUTINE RELEASE	00100000
1061	C	ROUTINE RELEASE	00100000
1062	C	ROUTINE RELEASE	00100000
1063	C	ROUTINE RELEASE	00100000
1064	C	ROUTINE RELEASE	00100000
1065	C	ROUTINE RELEASE	00100000
1066	C	ROUTINE RELEASE	00100000
1067	C	ROUTINE RELEASE	00100000
1068	C	ROUTINE RELEASE	00100000
1069	C	ROUTINE RELEASE	00100000
1070	C	ROUTINE RELEASE	00100000
1071	C	ROUTINE RELEASE	00100000
1072	C	ROUTINE RELEASE	00100000
1073	C	ROUTINE RELEASE	00100000
1074	C	ROUTINE RELEASE	00100000
1075	C	ROUTINE RELEASE	00100000
1076	C	ROUTINE RELEASE	00100000
1077	C	ROUTINE RELEASE	00100000
1078	C	ROUTINE RELEASE	00100000
1079	C	ROUTINE RELEASE	00100000
1080	C	ROUTINE RELEASE	00100000
1081	C	ROUTINE RELEASE	00100000
1082	C	ROUTINE RELEASE	00100000
1083	C	ROUTINE RELEASE	00100000
1084	C	ROUTINE RELEASE	00100000
1085	C	ROUTINE RELEASE	00100000
1086	C	ROUTINE RELEASE	00100000
1087	C	ROUTINE RELEASE	00100000
1088	C	ROUTINE RELEASE	00100000
1089	C	ROUTINE RELEASE	00100000
1090	C	ROUTINE RELEASE	00100000
1091	C	ROUTINE RELEASE	00100000
1092	C	ROUTINE RELEASE	00100000
1093	C	ROUTINE RELEASE	00100000
1094	C	ROUTINE RELEASE	00100000
1095	C	ROUTINE RELEASE	00100000
1096	C	ROUTINE RELEASE	00100000
1097	C	ROUTINE RELEASE	00100000
1098	C	ROUTINE RELEASE	00100000
1099	C	ROUTINE RELEASE	00100000
1100	C	ROUTINE RELEASE	00100000
1101	C	ROUTINE RELEASE	00100000
1102	C	ROUTINE RELEASE	00100000
1103	C	ROUTINE RELEASE	00100000
1104	C	ROUTINE RELEASE	00100000
1105	C	ROUTINE RELEASE	00100000
1106	C	ROUTINE RELEASE	00100000
1107	C	ROUTINE RELEASE	00100000
1108	C	ROUTINE RELEASE	00100000
1109	C	ROUTINE RELEASE	00100000
1110	C	ROUTINE RELEASE	00100000
1111	C	ROUTINE RELEASE	00100000
1112	C	ROUTINE RELEASE	00100000
1113	C	ROUTINE RELEASE	00100000
1114	C	ROUTINE RELEASE	00100000
1115	C	ROUTINE RELEASE	00100000
1116	C	ROUTINE RELEASE	00100000
1117	C	ROUTINE RELEASE	00100000
1118	C	ROUTINE RELEASE	00100000
1119	C	ROUTINE RELEASE	00100000
1120	C	ROUTINE RELEASE	00100000

CARD NO	INPUT LISTING	CONTENT	AIR INJECTION SYSTEM MODULE
1017	1000 WRITE(6,80) 1, 5(11)		00100000
1018	05 FORMAT: WARNING FROM MODULE IN AIR INJECTION SYSTEM /		00100000
1019	1 112, 113, 114, 115 IS RECTANGLE OR ROUNDED RECT.,		00100700
1020	2 112, 113, 114, 115 IS RECTANGLE OR ROUNDED RECT.,		00100710
1021	110 S(1) = (BATH(1+0) - S(2)*S(2))/S(1)/S(2)		00100700
1022	S(3) = (BATH(1+0) - S(2)*S(2))/S(1)/S(2)		00100700
1023	IF(S(1)) 111,112,113		00100740
1024	111 S(1) = S(2)		00100700
1025	112 IF(S(2)) 114,115,116		00100700
1026	114 S(3) = S(2)		00100700
1027	115 MDX(1) = S(1)		00100700
1028	MDX(1) = S(2)*S(1)		00100700
1029	MDX(1) = S(3)		00100000
1030	BLX(1) = S(2)*MDX(1) + S(1)/S(2)*MDX(1)		00100010
1031	BLX(1) = BLX(1)		00100000
1032	MDX(1) = S(2)*MDX(1) + S(1)/S(2)*MDX(1)		00100030
1033	IF(S(2) - MDX(1)) 116,117,200		00100040
1034	116 S(1) = MDX(1)*S(1) - S(2)/S(2)		00100000
1035	S(2) = MDX(1)*S(2)/S(2) + MDX(1)		00100000
1036	S(3) = MDX(1)*S(3)/S(2) + MDX(1)		00100070
1037	MDX(1) = (S(1)*S(2) + S(3)*S(3)/S(2))/S(1)		00100000
1038	MDX(1) = MDX(1)		00100000
1039	MDX(1) = (S(1)*S(2) + S(3)*S(3)/S(2))/S(1)		00100000
1040	C IF R(2,0) ABSOLUTE RADIUS OF CURVATURE IS INFINITY IE FLAT PANEL		00100010
1041	200 CONTINUE		00100000
1042	J = 2		00100030
1043	IF(MDX) 200,200,200		00100040
1044	C CALCULATE LEADING EDGE SURFACE		00100000
1045	200 J = 3		00100000
1046	BLX(1) = BATH(2) - BATH(1)		00100070
1047	IF(MDX - 1) 210,210,200		00100000
1048	210 STH(1) = BLX(1)/S(2)*(BLX(2) + BLX(2))		00100000
1049	GO TO 200		00101000
1050	200 STH(1) = BLX(1)/S(2)*(BATH(1) + BLX(2) + S(2)*MDX(2))		00101010
1051	C CALCULATE SUBSEQUENT SECTIONS OR MORE IF NO L.E.		00101000
1052	200 GO 200 1-J,MDX		00101030
1053	BLX(1-1) = BATH(1+0) - BATH(1+0)		00101040
1054	STH(1-1) = BLX(1-1)/S(2)*(BATH(1+0) + BATH(1+0))		00101020
1055	200 CONTINUE		00101000
1056	C *** EXIT ***		00101070
1057	RETURN		00101000
1058	END		00101000
1059	C		
1060	C		
1061	C SUBROUTINE PRECUT		
1062	C		
1063	C		
1064	SUBROUTINE PRECUT		00000010
1065	C WRITTEN 20 MARCH 1978		00000000
1066	C TO DETERMINE CRITICAL RAMP DESIGN CRITERIA		00000030
1067	C		00000040
1068	COMMON TCDH(400)		00000000
1069	COMMON /PFRMT/ IP(100)		
1070	C		00000000
1071	DIMENSION S(200),T(200),DC(100),MD(200)		00000070
1072	DIMENSION EDH(200)		00000000
1073	DIMENSION BATH(100)		00000000
1074	DIMENSION S(100)		00000100
1075	DIMENSION AL(100),VM(100),VL(100),TDM(100),TDL(100)		00000110
1076	DIMENSION PWH(100),PWL(100)		00000120
1077	DIMENSION TH(100)		00000130
1078	C		00000140
1079	DO 100 I=1,TCDH(1),T(1),TCDH(200),DC(1),TCDH(101),		00000150
1080	TH(I),TCDH(100)		00000100
1081	DO 100 J=1,EDH(1),EDH(1)		00000170
1082	DO 100 K=1,BATH(1),BATH(100),PWH(1),PWL(1),		00000100
1083	PWH(100),PWL(100),BATH(100),JN(1),BATH(100),FACT		00000100
1084	DO 100 L=1,S(1)		00000200
1085	DO 100 M=1,AL(1),AL(100),VM(1),VM(100),VL(1),VL(100),		00000210
1086	T(1),TDM(1),T(100),TDL(1)		00000220
1087	DO 100 N=1,PWH(1),PWH(100),PWL(1),PWL(100)		00000230

CARD NO	CONTENTS	00100000
1046	RETURN	00100000
1047	END	00100000
1048	C	
1049	C	
1050	C	
1051	C	
1052	C	
1053	ROUTINE HELD	00100010
1054	C	00100000
1055	C	00100000
1056	C	00100000
1057	C	00100000
1058	C	00100000
1059	DEFINITION D(1000),T(1000),SC(100),ND(100)	00100070
1060	DEFINITION D(1000)	00100000
1061	DEFINITION S(100)	00100000
1062	DEFINITION MDH(10),ADM(10),SDH(10),BLM(10),BLM(10),SDH(10)	00100100
1063	DEFINITION BLDM(10),SPN(10),RLDM(10),RLDM(10),RCNH(10)	00100110
1064	C	00100100
1065	EQUIVALENCE (D(1),TCDH(1)),T(1),TCDH(1001),DC(1),TCDH(101),	00100120
1066	IND(1),TCDH(101))	00100140
1067	EQUIVALENCE (D(101),D(101))	00100100
1068	EQUIVALENCE (T(1),D(1))	00100100
1069	EQUIVALENCE (T(701),MDH(1)),T(701),ADM(1),T(771),SDH(1),	00100170
1070	T(701),BLM(1),T(701),BLM(1),T(701),SDH(1))	00100100
1071	EQUIVALENCE (T(101),BLDM(1)),T(101),SPN(1),T(101),RLDM(1),	00100100
1072	T(101),RLDM(1),T(101),RCNH(1))	00100000
1073	EQUIVALENCE (ND(101),1),ND(101),J)	00100210
1074	EQUIVALENCE (ND(101),NDH),ND(101),NDH),ND(101),NDH)	00100000
1075	C	00100230
1076	C	00100240
1077	IF(1 - MDH 10,00,00	00100000
1078	C	00100000
1079	10 00 10 1=1,MDH	00100270
1080	IF(DMDH(100)) 10,10,12	00100000
1081	10 DMDH(100) = DMDH(100)+DMDH(100) + DMDH(100)+D(10)/D(2)	00100000
1082	10 CONTINUE	00100000
1083	C	00100310
1084	10 00 00 1=1,MDH	00100000
1085	IF(DMDH(100)) 20,20,100	00100330
1086	C	00100340
1087	20 IF(DMDH(100)) 20,20,20	00100000
1088	C	00100350
1089	20 10H = 1	00100370
1090	DMDH(100) = D(24)	00100000
1091	00 TO 000	00100000
1092	20 IF(DMDH(100)) 20,20,20	00100400
1093	20 WRITE(6,00)	00100410
1094	00 FORMAT(44HWARNING FROM HELD IN AIR INDUCTION SYSTEM /	00100420
1095	1 4H,00HHELLE LIP GEOMETRY ERROR )	00100430
1096	C	00100440
1097	20 10H = 2	00100450
1098	DMDH(100) = DMDH(100)	00100460
1099	00 TO 000	00100470
1100	C	00100480
1101	100 S(1) = S(1)	00100490
1102	S(2) = S(2)+DMDH(100) + DMDH(100) - DMDH(100)/	00100500
1103	10(10) - S(2)+S(10)	00100510
1104	IF(S(2)) 101,101,100	00100520
1105	101 S(1) = DMDH(100)/10(2)+DMDH(100) + S(2)+DMDH(100)	00100530
1106	S(2) = S(2)	00100540
1107	C	00100550
1108	C	00100560
1109	00 TO 1000	00100570
1110	100 S(4) = 4000(DMDH(100),DMDH(100))	00100580
1111	S(5) = 4000(DMDH(100),DMDH(100))	00100590
1112	IF(S(5)) - S(2)+S(2) 100,100,110	00100600
1113	100 S(2) = S(2)+S(2)	00100610
1114	S(1) = DMDH(100)/10(2)+10(1)+S(2) + S(4) - S(2)+S(2))	00100620
1115	C	00100630
1116	C	00100640

[illegible]

CARD NO	INPUT LISTING	AUTOFLOW CHART SET - SHEEP	AIR INDUCTION SYSTEM MODULE
1000	EQUIVALENCE (7:100),TMS(1)		
1000	EQUIVALENCE (IND(101),1,(IND(102),J),(IND(103),K),(IND(117),ICRT)		00000240
1001	EQUIVALENCE (IND(100),NPAGE1,IND(104),IPN)		00000250
1001	C		00000260
1002	S(1) = D(2)		00000270
1003	C TEST FOR MAXIMUM P/FCY AT VM AND VL RAMP CRITICAL DESIGN PRES.		00000280
1004	DO 40 I=1,0		00000290
1005	IFN = I + 100		00000300
1006	CALL READP(1,TMS(1),100,IPN)		
1007	S(2) = PWTN(1)*D(30)/TMS(30)		00000320
1008	IF(S(1) - S(2)) 10,20,20		00000330
1009	10 PMS = PWTN(1)		00000340
2000	FCY = TMS(30)		00000350
2001	FSU = TMS(40)		00000360
2002	DENS = TMS(41)		00000370
2003	FACT = D(30)		00000380
2004	ICRT = 1		00000390
2005	K = 1		00000400
2006	S(1) = S(2)		00000410
2007	20 S(2) = PWTN(1)*D(40)/TMS(100)		00000420
2008	IF(S(1) - S(2)) 30,40,40		00000430
2009	30 PMS = PWTN(1)		00000440
2010	FCY = TMS(100)		00000450
2011	FSU = TMS(130)		00000460
2012	DENS = TMS(131)		00000470
2013	FACT = D(40)		00000480
2014	ICRT = 1		00000490
2015	K = 2		00000500
2016	S(1) = S(2)		00000510
2017	40 CONTINUE		00000520
2018	C STORE ULTIMATE HAPERSHOCK PRESSURE IN PMS AND DETERMINE MATL		00000530
2019	C 1 = ALUMINUM 2 = TITANIUM 3 = STEEL		00000540
2020	PMS = PMS*FACT		00000550
2021	PMAT = D(1)		00000560
2022	IF(DENS - 0.14) 40,42,42		00000570
2023	40 PMAT = D(3)		00000580
2024	IF(DENS - 0.20) 44,46,46		00000590
2025	44 PMAT = D(2)		00000600
2026	46 CONTINUE		00000610
2027	C WRITE CRITICAL RAMP DESIGN POINT DATA		00000620
2028	S(1) = VM(ICRT)		00000630
2029	S(2) = TDM(ICRT) - EQU(20)		00000640
2030	W(1) = K) 50,70,70		00000650
2031	50 S(1) = VL(ICRT)		00000660
2032	S(2) = TDM(ICRT) - EQU(20)		00000670
2033	C WRITE OUTPUT		00000680
2034	70 IF(IP(00)1001,5001,5002		00000690
2035	0001 WRITE(0,00) ICRT,ALT(ICRT),S(1),S(2),PMS,FACT,FCY,FSU,DENS		00000700
2036	00 FORMAT(1H,40X,30H*** RAMP DESIGN CONDITIONS ***.10X,		
2037	1 21H** PRECORT - (P(00) ****		
2038	14X,0POINT,20X,14X,0X,0MULTITUDE,14X,F10.2/0X,0SPELDT,17X,		00000710
2039	0F10.2/0X,10TEMPERATURE - F,7X,F10.2/0X,10PRESSURE - PSIA,		00000720
2040	27X,F10.2/0X,20LIMIT TO ULT. FACTOR,2X,F10.2/0X,		00000730
2041	4170COMPRESSION YIELD,0X,F10.2/0X,21ULTIMATE SHEAR STRESS,		00000740
2042	0F11.2/0X,10MATERIAL DENSITY,11X,10.3)		00000750
2043	C *** EXIT ***		00000760
2044	0002 CONTINUE		00000770
2045	RETURN		00000780
2046	000		00000790
2047	C		00000800
2048	C		
2049	C		
2050	C		
2051	C		
2052	C		
2053	C SUBROUTINE PLOMS		00200010
2054	C WRITTEN 7 APRIL 1972		00200020
2055	C TO DEVELOP PLOM AND FITTING HEIGHTS		00200030
2056	C DIMENSION EQU(100) DATA(40),DATA(00)		00200040
2057	C		00200050
2058	C COMMON TCON(400)		00200060
2059	C		00200070

05/05/74	INPUT LISTING	AUTOFLEX CHART SET - BACK	AIR INDUCTION SYSTEM MODULE
CARD NO	****	CONTENTS	****
0000		DIMENSION 0(000),T(000),DC(100),ND(000)	00000000
0000		DIMENSION SUPH(000)	00000000
0001		DIMENSION S(100),TOT(100),TMS(100)	00000100
0002	C		00000110
0003		CBU(VALDICE 0(1),TCM(1),T(1),TCM(000),DC(1),TCM(101),	00000120
0004		IND(1),TCM(400))	00000130
0005		CBU(VALDICE 0(0),CBU(1),0(00),DATS(1),0(00),BATH(1)	00000140
0006		CBU(VALDICE 0(170),SUPH(1)	00000150
0007		CBU(VALDICE 1(1),S(1),T(101),TOT(1),T(100),TMS(1)	00000160
0008		CBU(VALDICE 1TOT(0),MTP(1),TOT(02),MTP(0),TOT(03),MTP(1),	00000170
0009		1TOT(04),MTP(0)	00000180
0010		CBU(VALDICE 1ND(04),IP(1),ND(101),1)	00000190
0011	C		00000200
0012		IF(DATS(02)) 000,000,10	00000210
0013	C	INBOARD PYLON HEIGHT	00000220
0014		10 MTP1 = DATS(02)*DATS(23)/0(17)*CBU(100)	00000230
0015		SUPH(4) = MTP1	00000240
0016		SUPH(42) = SUPH(02) + DATS(23)*TAN(DATS(00)*0(10)/0(2)	00000250
0017		IF(DATS(1) - 0(2)) 000,000,00	00000260
0018		00 IF(DATS(04)) 000,000,00	00000270
0019	C	OUTBOARD PYLON HEIGHT	00000280
0020		02 MTP0 = DATS(04)*DATS(23)/0(17)*CBU(100)	00000290
0021		SUPH(43) = MTP0	00000300
0022		SUPH(44) = SUPH(02) + DATS(23)*TAN(DATS(00)*0(10)/0(2)	00000310
0023	000	CONTINUE	00000320
0024	C	FITTING - KING OR FUELSAE ATTACH	00000330
0025		214 S(1) = 0(04)	00000340
0026		00 216 1=1,30	00000350
0027		S(1) = S(1) + TOT(1+00)	00000360
0028		216 CONTINUE	00000370
0029		S(1) = S(1) + DATS(0)*DATS(7)/DATS(1)	00000380
0030		IP(4) = 100	
0031		CALL REACH(1,TMS(1),100,IP(4)	00000400
0032		S(2) = (TMS(100) + TMS(100))/TMS(101)	00000410
0033		S(3) = (TMS(100) + TMS(107))/TMS(101)	00000420
0034		S(4) = CBU(100)/S(2) + CBU(110)/S(3) + CBU(111)	00000430
0035	C	00 INBOARD FITTING HEIGHT	00000440
0036		IF(DATS(01)) 000,000,000	00000450
0037	000	S(5) = DATS(20)*02*DATS(14)/0(12)/0(00)	00000460
0038		S(6) = BATH(0)/0(2) + DATS(23)	00000470
0039		S(7) = S(1) + TOT(01)	00000480
0100		S(8) = S(1)*S(5)*S(6)	00000490
0101	230	S(9) = DATS(02)*DATS(00)	00000500
0102		IF(S(9)) 000,000,000	00000510
0103		000 S(9) = 0(10)	00000520
0104		00 S(10) = (S(7)*DATS(27) + S(8)/S(9))/0(30)	00000530
0105		00 TO 070	00000540
0106	C	HORIZONTALLY MOUNTED	00000550
0107	000	S(6) = BATH(10)/0(2) + DATS(23)	00000560
0108		S(7) = S(1) + TOT(01)	00000570
0109		S(8) = S(1)*DATS(27)*S(6)	00000580
0110		00 TO 030	00000590
0111	070	MTP1 = S(10)*S(4)	00000600
0112		SUPH(27) = MTP1	00000610
0113		SUPH(20) = SUPH(02) + DATS(23)*TAN(DATS(00)*0(10)	00000620
0114	C	00 OUTBOARD FITTINGS	00000630
0115		17(DATS(1) - 0(2)) 000,000,000	00000640
0116	C	VERTICALLY MOUNTED ONLY	00000650
0117	000	S(5) = DATS(20)*02*DATS(17)/0(12)/0(00)	00000660
0118		S(6) = BATH(0)/0(2) + DATS(23)	00000670
0119		S(7) = S(1) + TOT(02)	00000680
0120		S(8) = S(1)*S(5)*S(6)	00000690
0121		S(9) = DATS(04)*DATS(00)	00000700
0122		IF(S(9)) 000,000,000	00000710
0123	000	S(9) = 0(10)	00000720
0124		00 S(10) = (S(7)*DATS(27) + S(8)/S(9))/0(30)	00000730
0125		MTP0 = S(10)*S(4)	00000740
0126		SUPH(20) = MTP0	00000750
0127		SUPH(40) = SUPH(02) + DATS(23)*TAN(DATS(00)*0(10)	00000760
0128	000	CONTINUE	00000770
0129		RETURN	00000780

CARD NO	CONTENTS	00000000
0130	END	00000700
0131	C	
0132	C	
0133	C	
0134	C	
0135	C	
0136	C	
0137	C	
0138	C	
0139	C	
0140	C	
0141	C	
0142	C	
0143	C	
0144	C	
0145	C	
0146	C	
0147	C	
0148	C	
0149	C	
0150	C	
0151	C	
0152	C	
0153	C	
0154	C	
0155	C	
0156	C	
0157	C	
0158	C	
0159	C	
0160	C	
0161	C	
0162	C	
0163	C	
0164	C	
0165	C	
0166	C	
0167	C	
0168	C	
0169	C	
0170	C	
0171	C	
0172	C	
0173	C	
0174	C	
0175	C	
0176	C	
0177	C	
0178	C	
0179	C	
0180	C	
0181	C	
0182	C	
0183	C	
0184	C	
0185	C	
0186	C	
0187	C	
0188	C	
0189	C	
0190	C	
0191	C	
0192	C	
0193	C	
0194	C	
0195	C	
0196	C	
0197	C	
0198	C	
0199	C	
0200	C	

LINE NO	INPUT LISTING	AMPLUM CHART SET - DEEP	AIR INDUCTION SYSTEM FEEDBACK
0001	C		00000000
0002	C		00000000
0003	IF (IP107) 0001.0001.100		
0004	0001 CONTINUE		
0005	WRITE(0.00)		00000070
0006	00 FORMAT(10X,10X,BUILT-IN PARAMETERS,00X,00** RAPP - (P107) **		
0007	1 / 1		
0008	C		00000000
0009	00 100 10-1.00		00000700
0010	1 = 10-4-0		00000710
0011	IF 10 = 0100.01.03		00000700
0012	01 0110011 - 3.01010.100.100		
0013	010 WRITE(0.00)		
0014	02 FORMAT(10X,10** 2 RAPP SYSTEM **)		00000700
0015	00 TO 00		00000700
0016	03 IF 10 = 031011.04.00		
0017	011 0110011 - 3.0100.100.100		
0018	04 0110011 - 3.0100.040.100		
0019	040 WRITE(0.00)		
0020	05 FORMAT(10X,10** 3 RAPP SYSTEM **)		00000700
0021	00 TO 00		00000700
0022	06 IF 10 = 061012.07.00		
0023	012 0110011 - 3.0100.00.100		
0024	07 0110011 - 3.0100.100.070		
0025	070 WRITE(0.00)		
0026	08 FORMAT(10X,10** 4 RAPP SYSTEM **)		00000000
0027	00 TO 00		00000000
0028	09 IF 10 = 091013.00.00		
0029	013 0110011 - 3.0100.100.00		
0030	00 WRITE(0.01)		
0031	01 FORMAT(10X,10** MINIMUM GAGES **,00X,		
0032	1 00** RAPP - (P107) **)		
0033	00 WRITE(0.10) F(1),F(1+1),F(1+2),F(1+3),F(1+4),F(1+5),F(1+6),		00000070
0034	1 F(1+7),F(1+8),F(1+9),BRIN		00000000
0035	101 FORMAT(10X,10X,F10.3)		00000000
0036	100 CONTINUE		00000000
0037	C		00000000
0038	C		00000000
0039	WRITE(0.10) (BATHIN),10-1.10)		00000070
0040	10 FORMAT(10X,10XINPUT DATA/		
0041	1 10X,00XNUMBER OF RAPP F10.2/		
0042	0 10X,00XCONST MD (0-0700,1-4000) F10.2/		00000000
0043	0 10X,00XDOWNERBACK PRESSURE (PSI) F10.2/		00001000
0044	0 10X,00XLENGTH OF RAPP 1 (IN) F10.2/		00001010
0045	0 10X,00XLENGTH OF RAPP 2 (IN) F10.2/		00001020
0046	0 10X,00XLENGTH OF RAPP 3 (IN) F10.2/		00001030
0047	0 10X,00XLENGTH OF RAPP 4 (IN) F10.2/		00001040
0048	0 10X,00XWIDTH OF RAPP 1 (IN) F10.2/		00001050
0049	0 10X,00XWIDTH OF RAPP 2 (IN) F10.2/		00001060
0050	0 10X,00XWIDTH OF RAPP 3 (IN) F10.2/		00001070
0051	0 10X,00XWIDTH OF RAPP 4 (IN) F10.2/		00001080
0052	0 10X,00XFCY (PSI) F10.2/		00001090
0053	0 10X,00XFSU (PSI) F10.2/		00001100
0054	0 10X,00XDENSITY OF MATERIAL ALB/CM IN) F10.2/		00001110
0055	0 10X,00XMATERIAL (1-4L,2-7L,3-0T) F10.2/		00001120
0056	0 10X,00XLIMIT TO ULTIMATE FACTOR F10.2/		00001130
0057	C		00001140
0058	WRITE(0.012)		00001150
0059	012 FORMAT(10X,00XCHANGES TO BUILT-IN PARAMETERS/		00001160
0060	0000 CONTINUE		
0061	C		00001170
0062	NAME = 0		00001180
0063	00 000 10-1.00		00001190
0064	IF (BATHIN-00) - BRIN) 001.000.001		00001200
0065	001 1 = 10-4-0		00001210
0066	NAME = 1		00001220
0067	WRITE(0.10) F(1),F(1+1),F(1+2),F(1+3),F(1+4),F(1+5),F(1+6),		00001230
0068	1 F(1+7),F(1+8),F(1+9),BATHIN-00)		00001240
0069	000 CONTINUE		00001250
0070	C		00001260
0071	IF (NAME) 10X,101.100		00001270

05/09/79

## INPUT LISTING

AUTOFLOW CHART SET - SHEEP

AIR INDUCTION SYSTEM MODULE

CARD NO	CONTENTS	0000
0070	101 WRITE(0,100)	00001200
0075	102 FORMAT( 2X,10X** NONE **)	00001200
0076	C	00001200
0078	103 MAT = 100AT	00001210
0079	C	00001220
0077	00 TO 1001,1002,1003,10AT	00001230
0078	C	00001240
0079	101 TC = TCA	00001250
0080	TM = TMA	00001260
0081	TS = TSA	00001270
0082	TEARF = TEARFA	00001280
0083	TEARR = TEARRA	00001290
0084	00 TO 1005	00001300
0085	C	00001310
0086	102 TC = TCT	00001320
0087	TM = TMT	00001330
0088	TS = TST	00001340
0089	TEARF = TEARFT	00001350
0090	TEARR = TEARRT	00001360
0091	00 TO 1005	00001370
0092	C	00001380
0093	103 TC = TCS	00001390
0094	TM = TMS	00001400
0095	TS = TSS	00001410
0096	TEARF = TEARFS	00001420
0097	TEARR = TEARRS	00001430
0098	C	00001440
0099	104 IF 1001 - 3.01500,510,940	00001450
2300	C	00001460
2301	900 ML = 10021 * ML1	00001470
2302	MT = 10022 * M1	00001480
2303	ML = APARK(ML,MT)	
2304	MT = ML	
2305	MLM = 10021	00001490
2306	M = M1	00001500
2307	ML = ML1	00001510
2308	0001M = 2.0	00001520
2309	100 = 1	00001530
2310	C	00001540
2311	101 COND1:000,000,502	00001550
2312	C	00001560
2313	902 ML = APARK(ML,MT)	00001570
2314	MT = ML	
2315	00 TO 010	00001580
2316	C	00001590
2317	904 MTL1 = MTL	00001600
2318	MTMT1 = MTMT	00001610
2319	C	00001620
2320	ML = 10022 * ML2	00001630
2321	MT = 10022 * M2	00001640
2322	ML = APARK(ML,MT)	
2323	MT = ML	
2324	MTA = 10022 * M2	00001650
2325	MLM = 10022	00001660
2326	M = M2	00001670
2327	ML = ML2	00001680
2328	0001M = 1.0	00001690
2329	100 = 2	00001700
2330	00 TO 000	00001710
2331	C	00001720
2332	905 MTL2 = MTL	00001730
2333	MTMT = MTMT	00001740
2334	MTMA = MTMTA	00001750
2335	00 TO 000	00001760
2336	C	00001770
2337	910 ML = 10031 * ML1	00001780
2338	MT = 10032 * M1	00001790
2339	ML = APARK(ML,MT)	
2340	MT = ML	
2341	MLM = 10031	00001800
2342	M = M1	00001810

00/00/74	INPUT LISTING	AUTOFLON CHART SET - SHEET	AIR INJECTION SYSTEM MODULE
CARD NO	****	CONTENTS	****
0203	HL = HL1		00001000
0204	SLM1 = 3.0		00001000
0205	MS = 3		00001000
0206	C		00001000
0207	IF (CONST1000,000,010		00001000
0208	C		00001070
0209	010 HL = APXK1(HL,MT)		00001000
0210	MT = HL		
0211	GO TO 010		00001000
0212	C		00002000
0213	014 MTHL1 = MTHL		00002010
0214	MTHL1 = MTHL		00002000
0215	C		00002030
0216	HL = 1000 + HL2		00002040
0217	MT = 1000 + MS		00002000
0218	HL = APXK1(HL,MT)		
0219	MT = HL		
0220	XIM = XIM00		00002000
0221	M = MS		00002070
0222	HL = HL2		00002000
0223	SLM1 = 2.0		00002000
0224	MS = 4		00002100
0225	C		00002110
0226	IF (CONST1000,000,010		00002100
0227	C		00002130
0228	010 HL = APXK1(HL,MT)		00002140
0229	MT = HL		
0230	GO TO 010		00002100
0231	C		00002100
0232	010 MTHL2 = MTHL		00002170
0233	MTHL2 = MTHL		00002100
0234	C		00002100
0235	HL = 1000 + HL3		00002000
0236	MT = 1000 + MS		00002100
0237	HL = APXK1(HL,MT)		
0238	MT = HL		
0239	MTHA = MTHAS + MS		00002000
0240	XIM = XIM00		00002030
0241	M = MS		00002040
0242	HL = HL3		00002000
0243	SLM1 = 1.0		00002000
0244	MS = 5		00002070
0245	GO TO 000		00002000
0246	C		00002000
0247	000 MTHL3 = MTHL		00002000
0248	MTHL3 = MTHL		00002010
0249	MTHA = MTHA		00002000
0250	GO TO 000		00002030
0251	C		00002040
0252	000 HL = 1001 + HL1		00002000
0253	MT = 1000 + MS		00002000
0254	HL = APXK1(HL,MT)		
0255	MT = HL		
0256	XIM = XIM01		00002070
0257	M = MS		00002000
0258	HL = HL1		00002000
0259	SLM1 = 2.0		00002040
0260	MS = 5		00002010
0261	C		00002030
0262	IF (CONST1000,000,002		00002030
0263	C		00002040
0264	002 HL = APXK1(HL,MT)		00002000
0265	MT = HL		
0266	GO TO 010		00002000
0267	C		00002070
0268	004 MTHL1 = MTHL		00002000
0269	MTHL1 = MTHL		00002000
0270	C		00002000
0271	HL = 1002 + HL2		00002010
0272	MT = 1000 + MS		00002000
0273	HL = APXK1(HL,MT)		

05/05/74	INPUT LISTING	AUTOFLOW CHART SET - SHEEP	AIR INDUCTION SYSTEM MODULE
CARD NO	CONTENTS		
0414	MT = ML		
0415	XIM = XIM42		
0416	M = M2		00002530
0417	XL = XL2		00002540
0418	BLM = 2.0		00002550
0419	IND = 7		00002560
0420	C		00002570
0421	IF(CONST)000,000,040		00002580
0422	C		00002590
0423	040 ML = AMAX1(ML,MT)		00002600
0424	MT = ML		00002610
0425	GO TO 010		
0426	C		00002620
0427	040 MTHL2 = MTHL		00002630
0428	MTHL2 = MTHL		00002640
0429	C		00002650
0430	ML = 1044 * XL1		00002660
0431	MT = 10174 * M4		00002670
0432	ML = AMAX1(ML,MT)		00002680
0433	MT = ML		
0434	XIM = XIM44		
0435	M = M4		00002690
0436	XL = XL4		00002700
0437	BLM = 2.0		00002710
0438	IND = 8		00002720
0439	C		00002730
0440	IF(CONST)000,000,050		00002740
0441	C		00002750
0442	050 ML = AMAX1(ML,MT)		00002760
0443	MT = ML		00002770
0444	GO TO 010		
0445	C		00002780
0446	050 MTHL4 = MTHL		00002790
0447	MTHL4 = MTHL		00002800
0448	C		00002810
0449	ML = 1043 * XL3		00002820
0450	MT = 10174 * M3		00002830
0451	ML = AMAX1(ML,MT)		00002840
0452	MT = ML		
0453	MFA = 101744 * M3		
0454	XIM = XIM43		00002850
0455	M = M3		00002860
0456	XL = XL3		00002870
0457	BLM = 1.0		00002880
0458	IND = 9		00002890
0459	GO TO 000		00002900
0460	C		00002910
0461	060 MTHL3 = MTHL		00002920
0462	MTHL3 = MTHL		00002930
0463	MTHL3 = MTHL3		00002940
0464	GO TO 020		00002950
0465	C		00002960
0466	060 MTHL = XIM * DEMS * ML * (4.0 * (3.0 * TC * ML * TM) +		00002970
0467	• M * (TBAR * TBARR))		00002980
0468	GO TO 012		00002990
0469	C		00003000
0470	010 MTHL = XIM * M * ML * (2.0 * DEMS * TS * .00050 * ML * DCORE		00003010
0471	• .0120 * BACH)		00003020
0472	C		00003030
0473	010 MTHL = XIM * DEMS * M * BLM * (3.0 * TC * MT * TM)		00003040
0474	MTHL = XIM * DEMS * M * BLM * (3.0 * TC * MFA * TM)		00003050
0475	C		00003060
0476	GO TO(004,000,014,010,020,044,040,062,004),IND		00003070
0477	C		00003080
0478	020 CONTINUE		00003090
0479	C		00003100
0480	IF(IND) - 3.01250,300,400		00003110
0481	C		00003120
0482	030 P1 = 1021 * P45		00003130
0483	P2 = 1022 * P45		00003140
0484	C		00003150
			00003160

05/05/74	INPUT LISTING	AUTOFLIGHT CHART SET - 000P	AIR INDUCTION SYSTEM MESSAGE
LINE NO	CONTENTS		0000
0005	ALPHA = ALPHA * .01745329		0000170
0006	C		0000180
0007	V1 = XL1 * P1 * M2		0000190
0008	V2 = XL2 * P2 * M2		0000200
0009	C		0000210
0010	W = V1 / 2.0 / COS(ALPHA)		0000220
0011	RA = W * (1.0 - 1.0/7000) * V2 * (1.0 - 1.0/2.0/7000)		0000230
0012	R = W/7000 * V2/2.0/7000		0000240
0013	C		0000250
0014	XL = ARX(10001 * XL1, WTS * M1)		0000260
0015	WTS(10001000,000,000)		0000270
0016	C		0000280
0017	000 RILND = XL21 * EDG * V1 * XL1 / 2.0 / XL *		0000290
0018	* (XL1 / 2.0 / XL / WCY / FCY * 1.0 / WBU / FBW)		0000300
0019	RITRAN = XIT21 * EDG * XM * M1 * V1 / ACT *		0000310
0020	* (XM * M1 / XL / WCY / FCY * 1.0 / WBU / FBW)		0000320
0021	GO TO 270		0000330
0022	C		0000340
0023	000 RILND = XL21 * XL1 * (EDG * V1 * XL1 / 4.0 / XL / FCY *		0000350
0024	* (EDG * M1 * XL / 1700.0 * XM * M1 / 70.0)		0000360
0025	RITRAN = XIT21 * EDG * XM * M1 * V1 *		0000370
0026	* (XM * M1 / XL / FCY * 1.0 / FBW)		0000380
0027	C		0000390
0028	270 XL = ARX(10001 * XL2, WTS * M2)		0000400
0029	RILND = XL22 * EDG * XL2 / XL *		0000410
0030	* (XL21 * XL2 * (2.0 * W * XL21 * V2) / XL / WCY / FCY *		0000420
0031	* (W * XL21 * V2) / WBU / FBW)		0000430
0032	PHINE = XIT22 * EDG * W * XM * M2 / ACT *		0000440
0033	* (XM * M2 / XL / WCY / FCY * 1.0 / WBU / FBW)		0000450
0034	ACT = XIT22 * EDG * R * XM * M2 / ACT *		0000460
0035	* (XM * WTS / WCY / FCY * 1.0 / WBU / FBW)		0000470
0036	AMINE = PHINE * RA/W * XIT22/XIT22		0000480
0037	C		0000490
0038	RILND = ARX(RILND, MYL1)		0000500
0039	RITRAN = ARX(RITRAN, MYL1)		0000510
0040	RILND = ARX(RILND, MYL2)		0000520
0041	PHINE = ARX(PHINE, MYL1)		0000530
0042	ACT = ARX(ACT, MYL1)		0000540
0043	AMINE = ARX(AMINE, MYL1)		0000550
0044	C		0000560
0045	TOTAL = RILND + RITRAN + RILND + PHINE + ACT + AMINE		0000570
0046	C		0000580
0047	IF (IP(07)1000,000,000		0000590
0048	0000 CONTINUE		0000600
0049	WRITE(0,001)		0000610
0050	001 FORMATION,21REACTION FORCES (LBS),50000 RAPP - IP(07) **		0000620
0051	1 //		0000630
0052	WRITE(0,001R,07,RA		0000640
0053	001 FORMATION,21RAPP 2 ACTUATOR F10.0/		0000650
0054	* 100,20RAPP 2 FWD HINGE F10.0/		0000660
0055	* 100,20RAPP 2 AFT HINGE F10.0/		0000670
0056	WRITE(0,001)		0000680
0057	001 FORMATION //100,20RAPP HEIGHTS (LBS) //		0000690
0058	WRITE(0,001RILND,RITRAN,RILND,PHINE,ACT,AMINE,TOTAL		0000700
0059	001 FORMATION 100,20RAPP 1 - LONGITUDINAL F10.2/		0000710
0060	* 100,20RAPP 1 - TRANSVERSE F10.2/		0000720
0061	* 100,20RAPP 2 - LONGITUDINAL F10.2/		0000730
0062	* 100,20RAPP 2 - FORWARD HINGE F10.2/		0000740
0063	* 100,20RAPP 2 - ACTUATOR F10.2/		0000750
0064	* 100,20RAPP 2 - AFT HINGE F10.2//		0000760
0065	* 100,20TOTAL HEIGHT F10.2/		0000770
0066	C		0000780
0067	GO TO 000		0000790
0068	C		0000800
0069	000 P1 = WPS1 * P45		0000810
0070	P2 = WPS2 * P45		0000820
0071	P3 = WPS3 * P45		0000830
0072	C		0000840
0073	V1 = M1 * XL1 * P1		0000850
0074	V2 = M2 * XL2 * P2		0000860
0075	V3 = M3 * XL3 * P3		0000870

CARD NO	CONTENTS	0000
0006	C	00001000
0007	ALPHA = .01745325 * ALPHA3	00001000
0008	C	00001070
0009	R1 = (V1 * V2) / 2.0 / KC31	00001000
0010	R2 = V2 / 2.0 / COS(ALPHA)	00001000
0011	R3 = V1 * (1.0 - 1.0 / 2.0 / KC31) *	00001000
0012	* V2 / 2.0 * (1.0 - 1.0 / KC31)	00001000
0013	R4 = R2 / KC33 * V3 / 2.0 / KC33	00001000
0014	R5 = R3 * V3 - R4	00001010
0015	C	00001000
0016	ML = APM1(KC31 * ML1 , INT3 * M1)	00001000
0017	IF(CDST)310,310,320	00001000
0018	C	00001000
0019	310 R1LND = X1L31 * CDMS * V1 * ML1 / 4.0 / XCL *	00001000
0020	* (ML1 / ML / WCY / FCY * 2.0 / WBU / FBU)	00001000
0021	R1TRAN = X1T31 * CDMS * M1 * M1 / MCT * (R1 * V2 / 2.0 * R1) *	00001070
0022	* (M1 * M1 / ML / WCY / FCY * 1.0 / WBU / FBU)	00001000
0023	C	00001000
0024	ML = APM1(KC32 * ML2 , INT3 * M2)	00001000
0025	R2LND = X1L32 * CDMS * V2 * ML2 / 4.0 / XCL *	00001000
0026	* (ML2 / ML / WCY / FCY * 2.0 / WBU / FBU)	00001010
0027	R2TRAN = X1T32 * CDMS * M2 * M2 / MCT *	00001000
0028	* (M2 * M2 / ML / WCY / FCY * 1.0 / WBU / FBU)	00001030
0029	GO TO 330	00001040
0030	C	00001000
0031	320 R1LND = X1L31 * ML1 * (CDMS * V1 * ML1 / 4.0 / ML / FCY *	00001070
0032	* CDMS * M1 * ML / 1700.0 * DASH * M1 / 70.0)	00001000
0033	R1TRAN = X1T31 * CDMS * M1 * M1 * (R1 * V2 / 2.0 * R1) *	00001000
0034	* (M1 * M1 / ML / FCY * 1.0 / FBU)	00001100
0035	C	00001110
0036	ML = APM1(KC32 * ML2 , INT3 * M2)	00001120
0037	R2LND = X1L32 * ML2 * (CDMS * V2 * ML2 / 4.0 / ML / FCY *	00001130
0038	* CDMS * M2 * ML / 1700.0 * DASH * M2 / 70.0)	00001140
0039	R2TRAN = X1T32 * CDMS * M2 * M2 *	00001150
0040	* (M2 * M2 / ML / FCY * 1.0 / FBU)	00001160
0041	C	00001170
0042	330 ML = APM1(KC33 * ML3 , INT3 * M3)	00001170
0043	R3LND = X1L33 * CDMS * ML3 / XCL *	00001180
0044	* (KC32 * ML3 * (2.0 * R3 * KC32 * V3) / ML / WCY / FCY *	00001190
0045	* WFS * KC32 * V3) / WBU / FBU)	00001200
0046	PHINDE = X1T33 * CDMS * R3 * M3 * M3 / MCT *	00001210
0047	* (M3 * M3 / ML / WCY / FCY * 1.0 / WBU / FBU)	00001220
0048	ACT = X1T33 * CDMS * R3 * M3 * M3 / MCT *	00001230
0049	* (M3 * M3 / WCY / FCY * 1.0 / WBU / FBU)	00001240
0050	AMINDE = PHINDE * RAS/WFS * X1T33/X1T33	00001250
0051	C	00001260
0052	R1LND = APM1(R1LND , MTL1)	00001270
0053	R1TRAN = APM1(R1TRAN , MTL1)	00001280
0054	R2LND = APM1(R2LND , MTL2)	00001290
0055	R2TRAN = APM1(R2TRAN , MTL2)	00001300
0056	R3LND = APM1(R3LND , MTL3)	00001310
0057	PHINDE = APM1(PHINDE , MTL4)	00001320
0058	ACT = APM1(ACT , MTL4)	00001330
0059	AMINDE = APM1(AMINDE , MTL4)	00001340
0060	C	00001350
0061	TOTAL = R1LND + R1TRAN + R2LND + R2TRAN + R3LND *	00001360
0062	* PHINDE + ACT + AMINDE	00001370
0063	C	00001380
0064	IF(IP107)1007,0007,000	00001390
0065	0007 CONTINUE	
0066	WRITE(6,VB1)	00001400
0067	WRITE(6,VB2)R1,R2,R3,R4	00001410
0068	VB3 FORMATT(10X,20F4.0) ACTUATOR ,F10.0/	00001420
0069	* 10X,20F4.0) ACTUATOR ,F10.0/	00001430
0070	* 10X,20F4.0) FWD HINGE ,F10.0/	00001440
0071	* 10X,20F4.0) AFT HINGE ,F10.0/	00001450
0072	WRITE(6,VB4)	00001460
0073	WRITE(6,VB5)R1LND,R1TRAN,R2LND,R2TRAN,R3LND,	00001470
0074	* PHINDE,ACT,AMINDE,TOTAL	00001480
0075	VB6 FORMATT( 10X,20F4.0) - LONGITUDINAL ,F10.0/	00001490
0076	* 10X,20F4.0) - TRANSVERSE ,F10.0/	00001500

03/20/74	INPUT LISTING	AUTOFLEX CHART SET - BEEP	AIR INDUCTION SYSTEM MODULE
CARD NO	****	CONTENTS	****
0007	•	10N,20SLAPP 2 - LONGITUDINAL F10.2/	0000+500
0008	•	10N,20SLAPP 2 - TRANSVERSE F10.2/	0000+510
0009	•	10N,20SLAPP 3 - LONGITUDINAL F10.2/	0000+520
0010	•	10N,20SLAPP 3 - FORWARD HINGE F10.2/	0000+530
0011	•	10N,20SLAPP 3 - ACTUATOR F10.2/	0000+540
0012	•	10N,20SLAPP 3 - AFT HINGE F10.2//	0000+550
0013	•	10N,20TOTAL F10.2//	0000+560
0014	C		0000+570
0015	00 TO 000		0000+580
0016	C		0000+590
0017	400 P1 = 10P1 + P45		0000+600
0018	P2 = 10P2 + P45		0000+610
0019	P3 = 10P3 + P45		0000+620
0020	P4 = 10P4 + P45		0000+630
0021	C		0000+640
0022	V1 = M1 + XL1 + P1		0000+650
0023	V2 = M2 + XL2 + P2		0000+660
0024	V3 = M3 + XL3 + P3		0000+670
0025	V4 = M4 + XL4 + P4		0000+680
0026	C		0000+690
0027	SINVAR = SINVA * .01745323		0000+710
0028	SIGVAR = SIGVA * .01745323		0000+720
0029	C		0000+730
0030	SS = SIN(SINVAR)		0000+740
0031	CS = COS(SINVAR)		0000+750
0032	SS = SIN(SINVAR)		0000+760
0033	CS = COS(SINVAR)		0000+770
0034	TS = TAN(SINVAR)		0000+780
0035	C		0000+790
0036	R1 = (V1 + V2) / 2.0 / 10P4		0000+810
0037	R2 = V1 + (1.0 - 1.0 / 2.0 / 10P4) *		0000+820
0038	* V2 / 2.0 + (1.0 - 1.0 / 10P4)		0000+830
0039	RA3 = V4 + CS / 2.0		0000+840
0040	R23 = (V2 + SS - V4 + SS) * TS / 2.0 + V2 * CS / 2.0		0000+850
0041	R2 = (R23 + (10P1 + 10P2) * V3 + (0.5 - 10P3) - RA3 + 10P3) / 10P4000+860		
0042	R3 = (V3 + (0.5 - 10P1) * RA3 + (10P2 + 10P3) - R23 + 10P3) / 10P4000+870		
0043	C		0000+880
0044	XP7D = 10P1 + XL3 + (R23 + V3 + 10P1) / 2.0		0000+890
0045	XP7T = 10P3 + XL3 + (RA3 + V3 + 10P3) / 2.0		0000+900
0046	XPC = XL3 / 2.0 + (R23 - R2 + (1.0 - 2.0 * 10P1) + V3 / 4.0)		0000+910
0047	XP7D = MAX(ABS(XP7D), ABS(XP7T), ABS(XPC))		0000+920
0048	C		0000+930
0049	Z1 = R23		0000+940
0050	Z2 = Z1 + 10P1 + V3		0000+950
0051	Z3 = Z2 - R2		0000+960
0052	Z7 = RA3		0000+970
0053	Z8 = RA3 + 10P3 + V3		0000+980
0054	Z5 = Z8 - R3		0000+990
0055	V40 = MAX(ABS(Z1), ABS(Z2), ABS(Z3), ABS(Z5), ABS(Z6),		0000+010
0056	* ABS(Z7))		0000+020
0057	C		0000+030
0058	ML = MAX(10P1 + XL1, 10P4 + M1)		0000+040
0059	IF(CDSTN10,410,420		0000+050
0060	C		0000+060
0061	410 R1L0 = XL41 + SD05 * V1 + XL1 / 4.0 + XL *		0000+070
0062	* (XL1 / ML + 10P1 / FCY + 2.0 / 10P1 / FCY)		0000+080
0063	R1TR0 = XL141 + SD05 * XM + M1 / XCT + (R1 + V2 / 2.0 + R1) *		0000+090
0064	* (XM + M1 / ML + 10P1 / FCY + 2.0 / 10P1 / FCY)		0000+100
0065	C		0000+110
0066	ML = MAX(10P4 + XL4, 10P4 + M4)		0000+120
0067	R4L0 = XL44 + SD05 * V4 + XL4 / 4.0 + XL *		0000+130
0068	* (XL4 / ML + 10P4 / FCY + 2.0 / 10P4 / FCY)		0000+140
0069	R4TR0 = XL144 + SD05 * XM + M4 / XCT *		0000+150
0070	* (XM + M4 / ML + 10P4 / FCY + 2.0 / 10P4 / FCY)		0000+160
0071	C		0000+170
0072	ML = MAX(10P2 + XL2, 10P4 + M2)		0000+180
0073	R2L0 = XL42 + SD05 * V2 + XL2 / 4.0 + XL *		0000+190
0074	* (XL2 / ML + 10P2 / FCY + 2.0 / 10P2 / FCY)		0000+200
0075	R2TR0 = XL142 + SD05 * XM + M2 / XCT *		0000+210
0076	* (XM + M2 / ML + 10P2 / FCY + 2.0 / 10P2 / FCY)		0000+220
0077	00 TO 430		0000+230

05/08/74	INPUT LISTING	AUTOFLOW CHART SET - SHEET	AIR INJECTION SYSTEM MANUAL
CARD NO	CONTENTS		
0000	C		00000010
0000	400 RILONG = XILN1 * ML1 * (DEMS * V1 * ML1 / 4.0 / ML / FCY * * SCORE * M1 * ML / 1700.0 * DASH * M1 / 70.0)		00000020
0700	RITRAN = XITN1 * DEMS * XM * M1 * (RPI * VE / 2.0 * R1) * * (XM * M1 / ML / FCY * 1.0 / FBU)		00000030
0701			00000040
0702	C		00000050
0703	ML = AMAXI(1044 * XL4 * XMTN * M1)		00000060
0704	RILONG = XIL44 * XL4 * (DEMS * V4 * XL4 / 4.0 / ML / FCY * * SCORE * M4 * ML / 1700.0 * DASH * M4 / 70.0)		00000070
0705	RITRAN = XIT44 * DEMS * XM * M4 * V4 * * (XM * M4 / ML / FCY * 1.0 / FBU)		00000080
0706			00000090
0707	C		00000100
0708	ML = AMAXI(1042 * XL2 * XMTN * M2)		00000110
0709	RILONG = XIL42 * XL2 * (DEMS * V2 * XL2 / 4.0 / ML / FCY * * SCORE * M2 * ML / 1700.0 * DASH * M2 / 70.0)		00000120
0710	RITRAN = XIT42 * DEMS * XM * M2 * V2 * * (XM * M2 / ML / FCY * 1.0 / FBU)		00000130
0711			00000140
0712	C		00000150
0713	400 ML = AMAXI(1043 * XL3 * XMTN * M3)		00000160
0714	RILONG = XIL43 * DEMS * XL3 * XCL * * (2.0 * XW40 / ML / FCY / FCY * W40 / XFBU / FBU)		00000170
0715	PHINSE = XIT44 * DEMS * R2 * XM * M3 / XCT * * (XM * M3 / ML / FCY / FCY * 1.0 / XFBU / FBU)		00000180
0716	FACT = XIT44 * DEMS * R2 * XM * M3 / XCT * * (XM * XMTN / FCY / FCY * 1.0 / XFBU / FBU)		00000190
0717	ACT = FACT * XIT44 / XIT44 * R3 / R2		00000200
0718	ANINSE = PHINSE * XIT44 / XIT44 * R3 / R2		00000210
0719			00000220
0720	C		00000230
0721	RILONG = AMAXI(RILONG , MTHL1)		00000240
0722	RITRAN = AMAXI(RITRAN , MTHL1)		00000250
0723	RILONG = AMAXI(RILONG , MTHL2)		00000260
0724	RITRAN = AMAXI(RITRAN , MTHL2)		00000270
0725	RILONG = AMAXI(RILONG , MTHL3)		00000280
0726	RILONG = AMAXI(RILONG , MTHL4)		00000290
0727	RITRAN = AMAXI(RITRAN , MTHL4)		00000300
0728	PHINSE = AMAXI(PHINSE , MTHL1)		00000310
0729	FACT = AMAXI(FACT , MTHL1)		00000320
0730	ACT = AMAXI(ACT , MTHL1)		00000330
0731	ANINSE = AMAXI(ANINSE , MTHL1)		00000340
0732			00000350
0733	C		00000360
0734	TOTAL = RILONG + RITRAN + RILONG + RETRAN + RILONG * * PHINSE * FACT * ACT * ANINSE * RILONG + RITRAN		00000370
0735			00000380
0736	C		00000390
0737	IF(IIP(071)5000,5000,000		00000400
0738	0000 CONTINUE		00000410
0739	WRITE(0,401)		00000420
0740	WRITE(0,401)R1,R2,R3,R2,R3		00000430
0741	400 FORMAT(10X,20CLAMP 1 ACTUATOR ,F10.0/		00000440
0742	* 10X,20CLAMP 3 FWD ACTUATOR ,F10.0/		00000450
0743	* 10X,20CLAMP 3 AFT ACTUATOR ,F10.0/		00000460
0744	* 10X,20CLAMP 3 FWD HINSE ,F10.0/		00000470
0745	* 10X,20CLAMP 3 AFT HINSE ,F10.0/		00000480
0746	WRITE(0,404)		00000490
0747	WRITE(0,404)RILONG,RITRAN,RILONG,RETRAN,RILONG,PHINSE,FACT, * ACT,ANINSE,RILONG,RITRAN,TOTAL		00000500
0748	400 FORMAT( 10X,20CLAMP 1 - LONGITUDINAL ,F10.0/		00000510
0749	* 10X,20CLAMP 1 - TRANSVERSE ,F10.0/		00000520
0750	* 10X,20CLAMP 2 - LONGITUDINAL ,F10.0/		00000530
0751	* 10X,20CLAMP 2 - TRANSVERSE ,F10.0/		00000540
0752	* 10X,20CLAMP 3 - LONGITUDINAL ,F10.0/		00000550
0753	* 10X,20CLAMP 3 - FORWARD HINSE ,F10.0/		00000560
0754	* 10X,20CLAMP 3 - FORWARD ACTUATOR ,F10.0/		00000570
0755	* 10X,20CLAMP 3 - AFT ACTUATOR ,F10.0/		00000580
0756	* 10X,20CLAMP 3 - AFT HINSE ,F10.0/		00000590
0757	* 10X,20CLAMP 4 - LONGITUDINAL ,F10.0/		00000600
0758	* 10X,20CLAMP 4 - TRANSVERSE ,F10.0/		00000610
0759	* 10X,20CLAMP TOTAL ,F10.0/		00000620
0760	C		00000630
0761	000 RETURN		00000640
0762	C		00000650
0763	000		00000660

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03/28/74      INPUT LISTING      AUTOFLIGHT SET - 0400P      AIR INDUCTION SYSTEM MODULE

CARD NO      ****      CONTENTS      ****

2760      C
2770      C #####
2771      C      SUBROUTINE SPAL
2772      C #####
2773      C
2774      SUBROUTINE SPAL      0000010
2775      C      WRITTEN 20 MARCH 1972      0000020
2776      C      TO DETERMINE ATMOSPHERIC PROPERTIES FOR 9 POINTS ON V-A DIAGRAM      0000030
2777      C      0000040
2778      COMMON TCON(400)      0000050
2779      C      0000060
2780      COMMON /HISC/ IHISC(100)
2781      COMMON /SPRINT/ IPRINT
2782      C
2783      DIMENSION D(2000),T(2000),DC(100),ND(200)      0000070
2784      DIMENSION BATH(40)      0000080
2785      DIMENSION EQU(200)      0000090
2786      DIMENSION S(100)      0000100
2787      DIMENSION ALT(10),TDH(10),PO(10),O(10),CS(10),RND(10)      0000110
2788      DIMENSION WH(10),VL(10),OH(10),GL(10),DWH(10),DL(10),      0000120
2789      BATH(10),RATL(10),TDWL(10),TEML(10),PTM(10),PTL(10),PBH(10),      0000130
2790      SPAL(10)      0000140
2791      DIMENSION TITLE(30)      0000150
2792      C      0000160
2793      EQUIVALENCE (D(1),TCON(1)),(T(1),TCON(200)),(DC(1),TCON(410)),      0000170
2794      (ND(1),TCON(420))      0000180
2795      EQUIVALENCE (D(81),EQU(1))      0000190
2796      EQUIVALENCE (D(601),BATH(1))      0000200
2797      EQUIVALENCE (BATH(31),DVL0),(BATH(32),RAT0)      0000210
2798      EQUIVALENCE (D(731),TITLE(1))      0000220
2799      EQUIVALENCE (T(1),S(1))      0000230
2800      EQUIVALENCE (S(1),TEML7),(S(2),PRESH)      0000240
2801      EQUIVALENCE (T(20),ALT(1)),(T(21),TDH(1)),(T(22),PO(1)),      0000250
2802      (T(23),O(1)),(T(24),CS(1)),(T(25),RND(1))      0000260
2803      EQUIVALENCE (T(26),WH(1)),(T(27),VL(1)),(T(28),OH(1)),      0000270
2804      (T(29),GL(1)),(T(30),DWH(1)),(T(31),DL(1)),      0000280
2805      (T(32),RATL(1)),(T(33),RATL(1)),(T(34),TDWL(1)),      0000290
2806      (T(35),TEML(1)),(T(36),PTM(1)),(T(37),PTL(1)),      0000300
2807      (T(38),PBH(1)),(T(39),PBH(1))      0000310
2808      EQUIVALENCE (ND(50),NPAGE)      0000320
2809      EQUIVALENCE (ND(101),I),(ND(102),J)      0000330
2810      C      0000340
2811      DO 20 I=1,9      0000350
2812      2 IF(BATH(I+10)) 4,8,10      0000360
2813      4 BATH(I+10) = D(1) - BATH(I+10)      0000370
2814      GO TO 10      0000380
2815      8 BATH(I+10) = DVL0      0000390
2816      IF(DVL0) 2,10,10      0000400
2817      10 J = 20 - I      0000410
2818      ALT(J) = BATH(I+5)      0000420
2819      WH(J) = BATH(1)      0000430
2820      IF(BATH(I+10) - D(1)) 12,10,10      0000440
2821      12 VL(J) = WH(J) + BATH(I+10)      0000450
2822      GO TO 20      0000460
2823      10 VL(J) = WH(J)*BATH(I+10)      0000470
2824      20 CONTINUE      0000480
2825      C      INTERPOLATE FOR INTERMEDIATE ALTITUDES      0000490
2826      DO 40 I=1,4      0000500
2827      J = 100      0000510
2828      ALT(J) = (ALT(J-1) + ALT(J+1))/2      0000520
2829      40 CONTINUE      0000530
2830      C      DEVELOP ATMOSPHERIC TABLES - 9 ALTITUDES      0000540
2831      DO 100 I=1,9      0000550
2832      CALL TEMPR      0000560
2833      TDH(I) = TEMPL7      0000570
2834      PO(I) = PRESH      0000580
2835      O(I) = D(20) - ALT(I)*EQU(2)      0000590
2836      RND(I) = PO(I)/TDH(I)*EQU(22)      0000600
2837      CS(I) = (EQU(23)*O(I)*EQU(22)*TDH(I))**.5      0000610
2838      100 CONTINUE      0000620
2839      C      DETERMINE DYNAMIC PRESSURE AT INITIAL POINTS      0000630

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05/09/74	INPUT LISTING	AUTOFLOW CHART SET - SHARP	AIR INDUCTION SYSTEM MODULE
CARD NO	****	CONTENTS	****
0040	00 120 I=1,5		00000040
0041	J = 2*1 - 1		00000041
0042	0H(J) = R0H(J)/0(J)/0(2)*1WH(J)*CS(J)**2		00000042
0043	0L(J) = R0L(J)/0(J)/0(2)*1VL(J)*CS(J)**2		00000043
0044	120 CONTINUE		00000044
0045	C DETERMINE SPEED AND DYNAMIC PRESSURE AT INTERMEDIATE POINTS		00000045
0046	C STRAIGHT LINE INTERPOLATION ON DYNAMIC PRESSURE		00000046
0047	00 140 I=1,4		00000047
0048	J = 1*2		00000048
0049	IF(0H(J-1) - 0H(J)) 132,130,132		00000049
0050	130 0H(J) = 0H(J-1)		00000050
0051	0H(J) = R0H(J)/0(J)/0(2)*1WH(J)*CS(J)**2		00000051
0052	00 134		00000052
0053	132 0H(J) = (0H(J-1) + 0H(J))/0(2)		00000053
0054	0H(J) = (0(2)*0H(J)+0(J)/R0H(J))**.5/CS(J)		00000054
0055	134 IF(0L(J-1) - 0L(J)) 130,130,130		00000055
0056	130 0L(J) = 0L(J-1)		00000056
0057	0L(J) = R0L(J)/0(J)/0(2)*1VL(J)*CS(J)**2		00000057
0058	00 140		00000058
0059	130 0L(J) = (0L(J-1) + 0L(J))/0(2)		00000059
0060	0L(J) = (0(2)*0L(J)+0(J)/R0L(J))**.5/CS(J)		00000060
0061	140 CONTINUE		00000061
0062	C DETERMINE PRESSURE RECOVERY AND FLOW RATE AT ENGINE FACE		00000062
0063	C 0 POINTS		00000063
0064	00 400 I=1,5		00000064
0065	J = 2*1 - 1		00000065
0066	IF(BATH(1+IS)) 102,102,100		00000066
0067	102 IF(RATE) 104,104,200		00000067
0068	104 IF(0H(J) - 0(1)) 100,100,100		00000068
0069	100 RATH(J) = 0(1)		00000069
0070	00 170		00000070
0071	100 RATH(J) = 0(1) - EQU(24)*1WH(J) - 0(1)**EQU(25)		00000071
0072	170 IF(0L(J) - 0(1)) 172,172,174		00000072
0073	172 RATH(J) = 0(1)		00000073
0074	00 170		00000074
0075	174 RATH(J) = 0(1) - EQU(24)*1VL(J) - 0(1)**EQU(25)		00000075
0076	170 IF(J - 0) 170,200,200		00000076
0077	170 IF(0H(J-1) - 0(1)) 100,100,102		00000077
0078	100 RATH(J-1) = 0(1)		00000078
0079	00 104		00000079
0080	102 RATH(J-1) = 0(1) - EQU(24)*1WH(J-1) - 0(1)**EQU(25)		00000080
0081	104 IF(0L(J-1) - 0(1)) 100,100,100		00000081
0082	100 RATH(J-1) = 0(1)		00000082
0083	00 200		00000083
0084	100 RATH(J-1) = 0(1) - EQU(24)*1VL(J-1) - 0(1)**EQU(25)		00000084
0085	00 200		00000085
0086	100 RATH(J) = BATH(1+IS)		00000086
0087	RATH(J) = BATH(1+00)		00000087
0088	104 IF(1 - J) 102,200,200		00000088
0089	102 RATH(J-1) = (RATH(J-2) + RATH(J))/0(2)		00000089
0090	RATH(J-1) = (RATH(J-2) + RATH(J))/0(2)		00000090
0091	00 200		00000091
0092	200 RATH(J) = RATE		00000092
0093	RATH(J) = RATE		00000093
0094	00 101		00000094
0095	C		00000095
0096	200 IF(BATH(1+05)) 310,310,300		00000096
0097	310 0H(J) = EQU(26)		00000097
0098	0L(J) = EQU(26)		00000098
0099	IF(0H(J) - 0(1)) 312,312,300		00000099
0100	312 0H(J) = EQU(27)		00000100
0101	IF(0H(J) - EQU(27)) 310,310,300		00000101
0102	310 0H(J) = 0H(J)		00000102
0103	00 300		00000103
0104	200 IF(0L(J) - 0(1)) 302,302,330		00000104
0105	302 0L(J) = EQU(27)		00000105
0106	IF(0L(J) - EQU(27)) 304,330,330		00000106
0107	304 0L(J) = 0L(J)		00000107
0108	200 IF(1 - J) 330,330,400		00000108
0109	330 0H(J-1) = (0H(J-2) + 0H(J))/0(2)		00000109
0110	0L(J-1) = (0L(J-2) + 0L(J))/0(2)		00000110

**WIKI**

CARD NO	CONTENTS	
0002	EQUIVALENCE (NO(112),1V0)	001002
0003	C	001003
0004	S(1) = 0(1)	001004
0005	IF(DATS(1)) 50,50,20	001005
0006	DO S(1) = 0(1)/DATS(1)	001006
0007	C DATS(4) = CAPTURE AREA PER INLET	001007
0008	C DATS(5) = NUMBER OF INLETS	001008
0009	DO IF(1V0 - 5) 100,200,300	001009
0010	C	001010
0011	C *** HALF ROUND FIXED SPINE ***	001011
0012	100 MFTS = EQUI(20)*DATS(4)*DATS(5)/0(17)*S(1)	001012
0013	SLPM(12) = MFTS	001013
0014	SLPM(14) = DATS(5)	001014
0015	GO TO 500	001015
0016	C	001016
0017	C *** FULL-ROUND TRANSLATING SPINE ***	001017
0018	200 MFTS = EQUI(20)*DATS(4)*DATS(5)/0(17)*S(1)	001018
0019	SLPM(15) = MFTS	001019
0020	SLPM(16) = DATS(5)	001020
0021	GO TO 500	001021
0022	C	001022
0023	C *** TRANSLATING AND EXPANDING SPINE ***	001023
0024	300 MFTS = EQUI(20)*DATS(4)*DATS(5)/0(17)*S(1)	001024
0025	SLPM(17) = MFTS	001025
0026	SLPM(18) = DATS(5)	001026
0027	500 CONTINUE	001027
0028	C	001028
0029	*** EXIT ***	001029
0030	RETURN	001030
0031	END	001031
0032	C	001032
0033	C SUBROUTINE SUMMARY	001033
0034	C	001034
0035	C	001035
0036	C	001036
0037	C	001037
0038	C	001038
0039	C	001039
0040	C	001040
0041	C	001041
0042	C	001042
0043	C	001043
0044	C	001044
0045	C	001045
0046	C	001046
0047	C	001047
0048	C	001048
0049	C	001049
0050	C	001050
0051	C	001051
0052	C	001052
0053	C	001053
0054	C	001054
0055	C	001055
0056	C	001056
0057	C	001057
0058	C	001058
0059	C	001059
0060	C	001060
0061	C	001061
0062	C	001062
0063	C	001063
0064	C	001064
0065	C	001065
0066	C	001066
0067	C	001067
0068	C	001068
0069	C	001069
0070	C	001070
0071	C	001071
0072	C	001072
0073	C	001073
0074	C	001074
0075	C	001075
0076	C	001076
0077	C	001077
0078	C	001078
0079	C	001079
0080	C	001080
0081	C	001081
0082	C	001082
0083	C	001083
0084	C	001084
0085	C	001085
0086	C	001086
0087	C	001087
0088	C	001088
0089	C	001089
0090	C	001090
0091	C	001091
0092	C	001092
0093	C	001093
0094	C	001094
0095	C	001095
0096	C	001096
0097	C	001097
0098	C	001098
0099	C	001099
0100	C	001100
0101	C	001101
0102	C	001102
0103	C	001103
0104	C	001104
0105	C	001105
0106	C	001106
0107	C	001107
0108	C	001108
0109	C	001109
0110	C	001110
0111	C	001111
0112	C	001112
0113	C	001113
0114	C	001114
0115	C	001115
0116	C	001116
0117	C	001117
0118	C	001118
0119	C	001119
0120	C	001120
0121	C	001121
0122	C	001122

CARD NO	CONTENTS	0000
2053	20 S(1) = S(1) + (TOT(20) + TOT(20) + TOT(31) + TOT(32))	0000350
2054	1(BATR(17) + BATR(4) + BATR(5) + BATR(6)/D(2))	0000350
2055	GO TO 20	0000370
2056	20 S(1) = S(1) + (TOT(20) + TOT(20) + TOT(30) + TOT(31) + TOT(32))	0000380
2057	1(BATR(17) + BATR(4) + BATR(5) + BATR(6)/D(2))	0000380
2058	S(1) = S(1) + (TOT(33) + TOT(34))	0000400
2059	1(BATR(17) + BATR(4) + BATR(5) + BATR(6) + BATR(7)/D(2))	0000410
2060	20 SUPH(2) = S(1)/TOT(20)	0000420
2061	SUPH(1) = TOT(20)	0000430
2062	C SETUP AIR INDUCTION SYSTEM HEIGHTS AND C.O.	0000440
2063	C AMBROS PAGE 17	0000450
2064	70 S(1) = D(1)	0000460
2065	IF(DATS(1),07,0,0) S(1)=DATS(1)	0000470
2066	S(2)=D(2)	0000480
2067	DO 75 J=3,17,2	0000490
2068	SUPH(J) = SUPH(J)+S(1)	0000500
2069	SUPH(1) = SUPH(1) + SUPH(J)	0000510
2070	S(2) = S(2) + SUPH(J)-SUPH(J+1)	0000520
2071	75 CONTINUE	0000530
2072	SUPH(2) = S(2)/SUPH(1)	0000540
2073	IF(DATS(1)) 200,200,00	0000550
2074	C FOR NACELLE TYPE MULT. HEIGHTS BY 2	0000560
2075	DO DO 80 J=21,40,4	0000570
2076	SUPH(J) = SUPH(J)+S(2)	0000580
2077	80 CONTINUE	0000590
2078	C ALSO SINCE OUTBOARD PILEN + FITTINGS ARE CALCULATED DO THEM.	0000600
2079	SUPH(20) = SUPH(20)+D(2)	0000610
2080	SUPH(43) = SUPH(43)+D(2)	0000620
2081	100 IF(D(2) - DATS(1)) 112,200,200	0000630
2082	112 SUPH(23) = SUPH(23)	0000640
2083	SUPH(24) = SUPH(22)	0000650
2084	SUPH(27) = SUPH(25)	0000660
2085	SUPH(28) = SUPH(26)	0000670
2086	SUPH(31) = SUPH(28)	0000680
2087	SUPH(32) = SUPH(30)	0000690
2088	SUPH(35) = SUPH(33)	0000700
2089	SUPH(36) = SUPH(34)	0000710
2090	SUPH(47) = SUPH(45)	0000720
2091	SUPH(48) = SUPH(46)	0000730
2092	SUPH(51) = SUPH(48)	0000740
2093	SUPH(52) = SUPH(50)	0000750
2094	200 S(1) = D(2)	0000760
2095	S(2) = D(2)	0000770
2096	DO 210 I=1,0	0000780
2097	J = 4+I	0000790
2098	S(1) = S(1) + SUPH(J-17)-SUPH(J-18)	0000800
2099	S(2) = S(2) + SUPH(J-18)-SUPH(J-20)	0000810
2100	SUPH(57) = SUPH(57) + SUPH(J-17)	0000820
2101	SUPH(58) = SUPH(58) + SUPH(J-18)	0000830
2102	210 CONTINUE	0000840
2103	SUPH(59) = S(1)/SUPH(57)	0000850
2104	IF(SUPH(59)) 214,214,212	0000860
2105	212 SUPH(60) = S(2)/SUPH(59)	0000870
2106	214 SUPH(61) = SUPH(57) + SUPH(59)	0000880
2107	SUPH(62) = (S(1) + S(2))/SUPH(61)	0000890
2108	IF(DATS(1)) 300,300,200	0000900
2109	200 SUPH(65) = SUPH(65)+DATS(1)	0000910
2110	SUPH(67) = SUPH(67)+DATS(1)	0000920
2111	SUPH(71) = SUPH(71)+DATS(1)	0000930
2112	SUPH(73) = SUPH(65) + SUPH(67) + SUPH(71)	0000940
2113	SUPH(74) = (SUPH(65)-SUPH(65) + SUPH(67)-SUPH(67) + SUPH(71))	0000950
2114	1(SUPH(73)/SUPH(73))	0000960
2115	C REVISE C6 TO FUELAGE SYSTEM	0000970
2116	200 S(1) = DATS(13)	0000980
2117	IF(D(2) - DATS(1)) 302,310,310	0000990
2118	302 S(1) = (DATS(13) + DATS(16))/D(2)	0001000
2119	310 DO 300 I=1,0	0001010
2120	J = 3+I	0001020
2121	IF(SUPH(J-1)) 312,300,312	0001030
2122	312 SUPH(J) = SUPH(J) + S(1)	0001040
2123	300 CONTINUE	0001050

CS/BS/74	INPUT LISTING	AUTOFLOW CHART SET - SHEET	AIR INDUCTION SYSTEM MODULE
CARD NO	CONTENTS		
3124	80 330 1=31,37		00021000
3125	J = 2+1		00021000
3126	IF(SUPH(J-1)) 300,330,300		00021070
3127	300 SUPH(J) = SUPH(J) + 5(1)		00021000
3128	300 CONTINUE		00021000
3129	5(1) = DAT5(13)		00021100
3130	5(2) = DAT5(16)		00021110
3131	80 400 1=1,10		00021100
3132	J = 4+1		00021130
3133	IF(SUPH(J-1)) 304,305,304		00021130
3134	304 SUPH(J-10) = SUPH(J-10) + 5(1)		00021140
3135	300 IF(SUPH(J-10)) 300,400,300		00021140
3136	300 SUPH(J-20) = SUPH(J-20) + 5(2)		00021150
3137	400 CONTINUE		00021100
3138	SUPH(75) = SUPH(51) + SUPH(73)		00021170
3139	SUPH(76) = (SUPH(51)+SUPH(62) + SUPH(73)+SUPH(74)+SUPH(75)		00021100
3140	C WRITE (PEAKPOINT OUTPUT		00021100
3141	WRITE(6,400)(MISC(IN),N=05,100)		00021200
3142	400 FORMAT(1H,BA10,17X,12H** SUPPLY **/1X,BA10//		
3143	1 2EX,574A. 1. 5. + ENGINE SECTION OR NOZZLE GROUP HEIGHT + C.O.		00021220
3144	2 74SUPPLY // 52X,3047.,7X,4C.0.,3EX,3047.,7X,4C.0. )		00021230
3145	C		00021240
3146	WRITE(6,400) (SUPH(1),1=1,10)		00021250
3147	400 FORMAT(1X,20HAIR INDUCTION SYSTEM,700,5711.2/2X,11HINLET MEDGE.		00021260
3148	1 745,5711.2/ 2X,11HAIR DUCTING,745,5711.2 /		00021270
3149	2 2X,20HINTAKE DOORS + OP. MECHANISM,745,5711.2 /		00021280
3150	3 2X,20HBYPASS DOORS + OP. MECHANISM,745,5711.2 /		00021290
3151	4 2X,20HARIABLE GEOMETRY STRUCTURE,745,5711.2 /		00021300
3152	5 2X,20HALF ROUND FIXED SPIKE,745,5711.2 /		00021310
3153	6 2X,20FULL ROUND TRANSLATING SPIKE,745,5711.2 /		00021320
3154	7 2X,20FULL TRANS. + EXPND. SPIKE,745,5711.2 / 1		00021330
3155	C		00021340
3156	WRITE(6,400) (SUPH(1),1=21,22),(SUPH(1),1=57,62)		00021350
3157	400 FORMAT(1X,74HINBOARD,10X,20HOUTBOARD,10X,20HTOTAL //		00021360
3158	+ 40X,3047.,7X,4C.0.,11X,3047.,7X,4C.0.,12X,20 74X,4C.0. /		00021370
3159	1 2X,10HENGINE MOUNTS,733,5711.2,700,5711.2/		00021380
3160	2 2X,10HBLADEHEADS + FRAMES,733,5711.2,700,5711.2/		00021390
3161	3 2X,20HCOVERING + STIFFENERS,733,5711.2,700,5711.2/		00021400
3162	4 2X, 20HLONGONS,733,5711.2,700,5711.2/		00021410
3163	5 2X, 20HSTIFFENERS, 733,5711.2,700,5711.2/		00021420
3164	6 2X, 20HFLANS,733,5711.2,700,5711.2/		00021430
3165	7 2X, 20HFRAMLL,733,5711.2,700,5711.2 /		00021440
3166	8 2X, 20HFOOLD,733,5711.2,700,5711.2 /		00021450
3167	9 2X,10HTOTAL ENG.SEC./MAC.,733,5711.2,700,5711.2,700,5711.2/1		00021460
3168	C		00021470
3169	WRITE(6,400) (SUPH(1),1=65,66),(SUPH(1),1=71,76)		00021480
3170	400 FORMAT(1X,10HACCESS DOORS,745,5711.2 /		00021490
3171	1 2X, 10HENGINE DOORS,745,5711.2/ 2X,10HEXTIOR FINISH,745,5711.2/0021500		
3172	2X,10HTOTAL MISC.,700,5711.2 //		00021510
3173	3 2X,20HTOTAL ENG.SEC./MAC.GROUP + MISC.,700, 5711.2 )		00021520
3174	C		00021530
3175	WRITE(6,500)(MISC(IN),N=05,100)		00021540
3176	500 FORMAT(1H,BA10,17X,12H** SUPPLY **/1X,BA10)		
3177	WRITE(6,502)		00021570
3178	502 FORMAT(1H0, 20X,474* * * P R O P U L S I O N G R O U P * *		00021580
3179	+ / 2X, 310----- )		00021590
3180	WRITE (6,505) ( SUPH(1), 1=1,11,2 )		00021600
3181	505 FORMAT(1H, 17X, 20HAIR INDUCTION SYSTEM, 770, 1712.2 / 2X,		00021610
3182	+ 11HINLET MEDGE, 767, 1712.2 / 2X, 11HAIR DUCTING, 767, 1712.2 /		00021620
3183	+ 2X, 20HINTAKE DOORS + OPERATING MECHANISM, 767, 1712.2 /		00021630
3184	+ 2X, 20HBYPASS DOORS + OPERATING MECHANISM, 767, 1712.2 / 2X,		00021640
3185	+ 20HARIABLE GEOMETRY STRUCTURE, 767, 1712.2 )		00021650
3186	IF (SUPH(13) .NE. 0.0) WRITE (6,510) SUPH(13)		00021660
3187	510 FORMAT (1H0, 22X, 20HALF ROUND FIXED SPIKE, 767, 1712.2 )		00021670
3188	IF (SUPH(15) .NE. 0.0) WRITE (6,512) SUPH(15)		00021680
3189	512 FORMAT(1H0,22X,20FULL ROUND TRANSLATING SPIKE,767,1712.2)		00021690
3190	IF (SUPH(17) .NE. 0.0) WRITE (6,514) SUPH(17)		00021700
3191	514 FORMAT (1H0, 22X, 20FULL TRANSLATING + EXPANDING SPIKE,767,1712.2)0021710		
3192	C		00021720
3193	WRITE(6,500)(MISC(IN),N=05,100)		00021730
3194	WRITE(6,520)		00021740



03/05/74	INPUT LISTING	AUTOFLON CHART SET - SHEEP	AIR INDUCTION SYSTEM MODULE
CARD NO	****	CONTENTS	****
3266	IF(ALOFT - EQU(17)) 100,100,57		00030380
3267	57 WRITE(6,00)		00030400
3268	00 FORMAT(10X,23H*** WARNING MESSAGE ***.10X,		00030410
3269	149H ALTITUDE IS BEYOND VALID RANGE OF PRESSURE)		00030420
3270	00 TO 50		00030430
3271	100 CONTINUE		00030440
3272	C		00030450
3273	C DEVELOP AMBIENT TEMPERATURE		00030460
3274	IF(ALOFT - EQU(11)) 110,125,120		00030470
3275	C ALTITUDE BETWEEN SEA LEVEL AND 35000.230 FT		00030480
3276	110 TEMP1 = EQU(10) - EQU(10)*ALOFT		00030490
3277	00 TO 630		00030500
3278	100 IF(ALOFT - EQU(9)) 125,125,140		00030510
3279	C ALTITUDE BETWEEN 35000.230 AND 85610.00 FT.		00030520
3280	125 TEMP1 = EQU(20)		00030530
3281	00 TO 630		00030540
3282	140 IF(ALOFT - EQU(8)) 145,160,160		00030550
3283	C ALTITUDE BETWEEN 85610.00 AND 104900.00 FT		00030560
3284	140 TEMP1 = EQU(20) + EQU(12)*(ALOFT - EQU(9))		00030570
3285	00 TO 630		00030580
3286	C ALTITUDE BETWEEN 104900.00 AND 194199.40 FT.		00030590
3287	100 TEMP1 = EQU(15) + EQU(14)*(ALOFT - EQU(8))		00030600
3288	IF(ALOFT - EQU(17)) 630,630,610		00030610
3289	610 WRITE(6,01)		00030620
3290	01 FORMAT(10X,23H*** WARNING MESSAGE ***.10X,		00030630
3291	149H ALTITUDE IS BEYOND VALID RANGE OF TEMPERATURE)		00030640
3292	630 CONTINUE		00030650
3293	RETURN		00030660
3294	END		00030670